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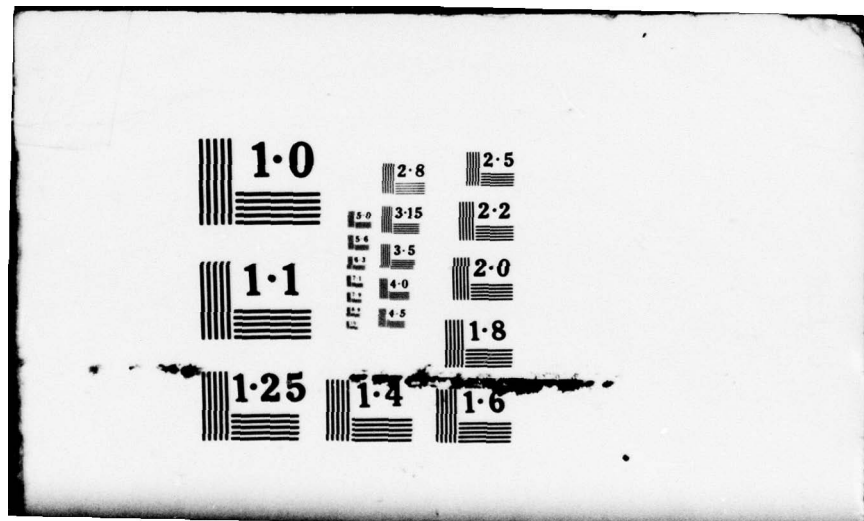
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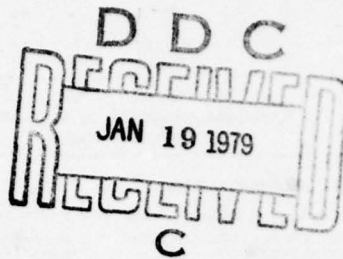
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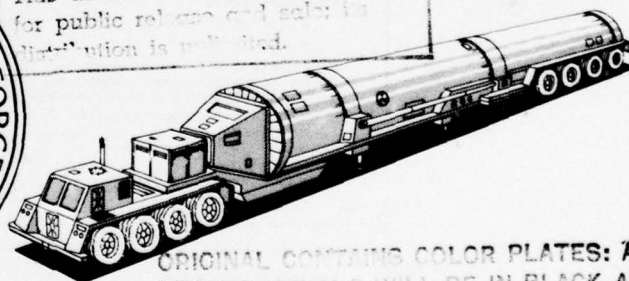


III

Missile Flight Testing



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Environmental Impact Analysis Process



FINAL
ENVIRONMENTAL IMPACT STATEMENT

MX: MILESTONE II

DEPARTMENT OF THE AIR FORCE

70 01 19 053

FINAL ENVIRONMENTAL IMPACT STATEMENT
MX MILESTONE II

VOLUME I: PROGRAM OVERVIEW

VOLUME I PRESENTS AN OVERVIEW OF THE ENTIRE MX SYSTEM INCLUDING:

- THE MX MISSILE AND BASING MODE ACQUISITION PROCESS
- THE ENVIRONMENTAL PROGRAM AND ENVIRONMENTAL STATEMENTS TO BE PREPARED FOR DECISION-MAKERS AND THE PUBLIC
- A SUMMARY OF THE POTENTIAL ENVIRONMENTAL EFFECTS OF PAST AND FUTURE MX DECISIONS
- IDENTIFICATION OF FUTURE ACTIONS ANTICIPATED AS PART OF THE MX SYSTEM

VOLUME II: FULL SCALE ENGINEERING DEVELOPMENT

VOLUME II ADDRESSES THE ENVIRONMENTAL IMPACTS OF EXPENDITURE OF RESOURCES TO DESIGN, CONSTRUCT, AND TEST MISSILE AND BASING MODE VEHICLE COMPONENTS AND THE ASSEMBLED MISSILE AND VEHICLES. KEY ISSUES ARE:

- EXPENDITURE OF \$5 TO \$7 BILLION FOR FULL-SCALE ENGINEERING DEVELOPMENT (FSED)
- CREATION OF JOBS THROUGHOUT THE NATION
- GROWTH INDUCEMENT CONCENTRATED IN 9 STATES
- CONSUMPTION OF ENERGY AND WATER RESOURCES
- ATMOSPHERIC EMISSIONS

VOLUME III: MISSILE FLIGHT TESTING

VOLUME III PROJECTS ENVIRONMENTAL IMPACTS OF MX FLIGHT TESTS ON VANDENBERG AIR FORCE BASE AND CENTRAL CALIFORNIA. KEY ISSUES INCLUDE:

- GROWTH RELATED IMPACTS TO NORTHERN SANTA BARBARA COUNTY
- FOUR CANDIDATE SITING AREAS (CSA) WERE EVALUATED TO ASSESS SITE SPECIFIC ENVIRONMENTAL IMPACTS RELATED TO THE FOLLOWING KEY ISSUES:
 - TRANSPORTATION
 - WATER RESOURCES
 - RARE OR ENDANGERED SPECIES
- CUMULATIVE IMPACTS OF MX, THE SPACE SHUTTLE, AND THE PROPOSED LNG PLANT
- AIR QUALITY
- ARCHAEOLOGY
- MINERAL RESOURCES

VOLUME IV: BASING MODE EVALUATION

VOLUME IV EVALUATES THE ENVIRONMENTAL IMPACTS ASSOCIATED WITH THE FOLLOWING FOUR BASING MODES:

- VERTICAL SHELTER
- BURIED TRENCH
- HORIZONTAL SHELTER
- SLOPE-SIDED POOL

THE POTENTIAL FOR ENVIRONMENTAL IMPACT ASSOCIATED WITH EACH BASING MODE IS EVALUATED AT SEVEN BASING MODE COMPARISON AREAS (BMCA) THROUGHOUT THE WESTERN UNITED STATES. KEY ENVIRONMENTAL ISSUES INCLUDE:

- VARIATION OF SPACING BETWEEN AIMPOINTS
- AREA SECURITY VERSUS POINT SECURITY
- DISTURBED OR UNDISTURBED ENVIRONMENT
- PUBLIC OR PRIVATE LAND
- WATER RESOURCES REQUIRED
- CONSTRUCTION RESOURCES REQUIRED
- ENERGY RESOURCES REQUIRED

VOLUME V: APPENDICES

VOLUME V CONTAINS:

- BIOLOGICAL APPENDICES AND SPECIES LISTS
- REGIONAL INDUSTRIAL MULTIPLIER SYSTEM (RIMS) DESCRIPTION
- BASING MODE EVALUATION
- GLOSSARY
- REFERENCES

VOLUME VI: PUBLIC COMMENTS

VOLUME VI PRESENTS PUBLIC RESPONSE TO THE DRAFT ENVIRONMENTAL IMPACT STATEMENT. INCLUDED IN THIS VOLUME ARE:

- LETTERS RECEIVED FROM AGENCIES AND ORGANIZATIONS
- RESPONSES TO QUESTIONS RAISED BY THE PUBLIC
- PUBLIC HEARING TRANSCRIPTS

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MISSILE FLIGHT TESTING SUMMARY

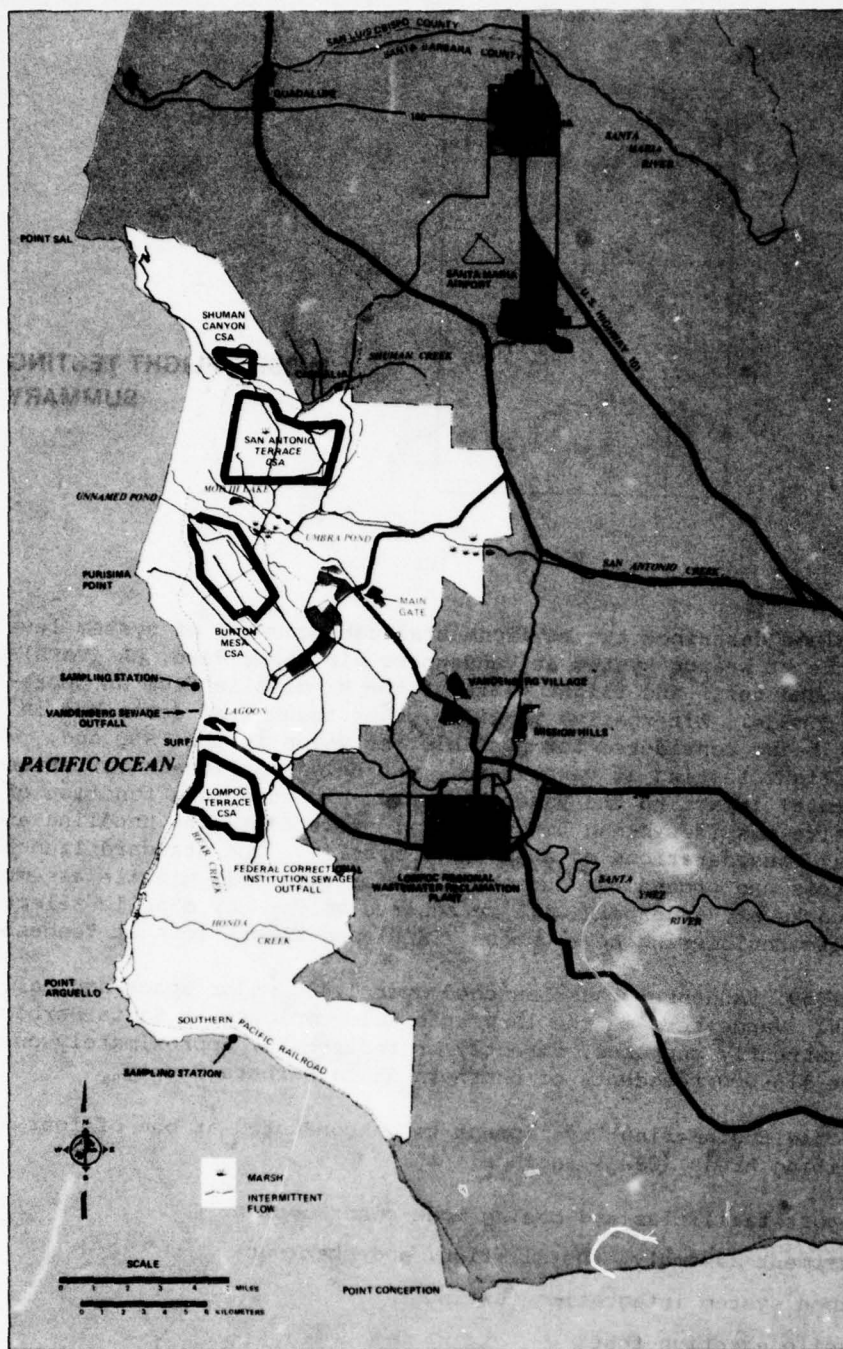
This volume describes the environmental consequences of system level testing of the MX weapon system at Vandenberg Air Force Base, CA (VAFB) including ground tests and flight tests of the MX missile from an operational basing mode. Alternative missiles other than MX as described in Volume I are being considered for possible inclusion in the FSED and, therefore, flight testing at Vandenberg. The only significant variations in environmental impact to the Vandenberg area expected as a function of the alternative missiles being considered are related to the handling and launch safety considerations of a specific missile. The standard launch safety analysis and procedures currently in force for all missile assembly and launch tasks at Vandenberg will be adhered to for any missile selected for Full-Scale Engineering Development (FSED) and Flight Test at Vandenberg.

Since 1959, Vandenberg has launched over 1,400 major space and ballistic missions. Vandenberg is the largest single employer in Santa Barbara County and currently supports, directly or indirectly, approximately one-third of the 115,000 residents of northern Santa Barbara County.

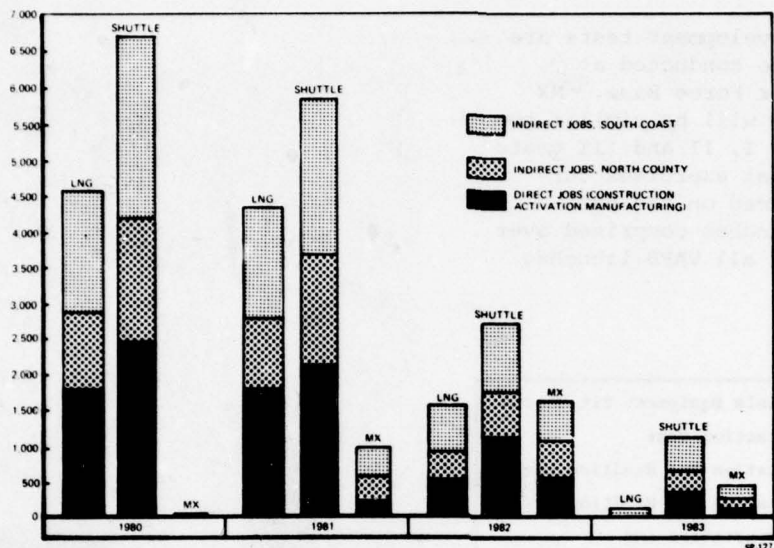
Full-Scale Engineering Development to be conducted at one of four Candidate Siting Areas (CSAs) include:

- support facilities and basing mode construction
- equipment assembly, installation, and checkout
- weapon system integration testing
- missile ejection tests
- missile flight tests

Construction of three shelters with required support facilities would disturb approximately 55 acres (22 ha). Alternatively, construction of the buried trench basing mode would require two 2 mi (3.2 km) trenches and disturb approximately 180 acres (72 ha). Two missile ejection tests may be conducted, one with an inert missile and the second



The relationship of the four candidate siting areas to surface waters on Vandenberg. Of particular importance from a biological perspective are San Antonio Creek, the habitat for an endangered fish, the unarmored threespined stickleback; and the area between Purisima Point and San Antonio Creek where 15 nesting pairs of the endangered least tern were located in the spring of 1978.



using a short-burn first stage. Twenty flight tests will be launched and flown in the Western Test Range during 1983 through 1987. The re-entry vehicles will be targeted into four separate target areas in the Pacific near the Marshall Islands and may be recovered after splashdown. Follow-on operational tests will be conducted by the Strategic Air Command throughout the life cycle of the weapon system.

Costs for the construction and operation of the MX test program at Vandenberg have been tentatively estimated at:

- construction of facilities \$50 million
- integrated testing & support systems \$90 million
- test equipment \$60 million
- MX flight tests \$200 million

Construction workers will number about 250 for the period of Spring 1981 through Winter 1982. These workers will tend to be transient as the combined Space Shuttle and the MX labor demand will exceed local supply. MX technical support will begin in early 1981 and increase through 1983 to 580 permanent personnel.

Key issues at Vandenberg and within its environs include:

- Topography: Alteration of terrain, destruction of natural vegetation, fugitive dust generation, and filling and diversion of minor stream channels will occur.

MX missile development tests are proposed to be conducted at Vandenberg Air Force Base. MX test launches will be similar to the Minuteman I, II and III tests and operational exercises currently performed on the base. Minuteman launches comprised over 60 percent of all VAFB launches during 1977.

Aerospace Vehicle Equipment Fit Checks
Umbilical Retraction Test
MGCS Transportation and Handling Test
IFSS Transportation and Handling Test
Canister Transportation and Handling Test
VAFB Stage I Transportation and Handling Test
VAFB Stage II Transportation and Handling Test
VAFB Stage III Transportation and Handling Test
VAFB Stage IV Transportation and Handling Test
Reentry System Transportation and Handling Test
Launch Complex Assembly and Launch Verification Test
Missile Ejection Tests
Reentry System Integration/Compatibility and Processing Test
Missile Guidance System Processing Test
IFSS Processing Test
Stage IV Processing Tests
Stages I, II, and III Flight Processing Tests
Missile Interface Test
Canister/Launch Complex Refurbishment Test
AVE/Laboratory Integration/Compatibility Tests
Missile Ejection Test (Short Burn)
Ground Test Missile Launch Complex Test



- Hydrology: Water requirements will be supplied from aquifers on the base. Withdrawal of water from these aquifers will not significantly affect offbase availability nor should it affect onbase suppliers.
- Biological Habitat: Endangered species and remote or unusual habitats could be adversely affected by project implementation at specific sites. The California least tern and unarmored threespine stickleback are federally protected species potentially affected.
- Air Quality: Missile launches will create a short-lived exhaust cloud which may include: hydrogen chloride, aluminum oxide, carbon monoxide, carbon dioxide, and water. The cloud will be dispersed quickly and will not result in toxic levels of pollutants beyond a few thousand feet from the launch point. No regional effects, permanent or temporary, are expected.
- Noise: Both construction activities and missile firings will generate noise. Noise impacts on population centers both on- and off-base will be minimal.
- Socioeconomic Impacts: The amount of growth anticipated can be absorbed by planned community facilities. Increased populations will place some added strain on housing and road networks. The planned phasing of construction for MX will soften the drop-off of construction employment resulting from completion of Space Shuttle construction.
- Temporary Housing: Temporary housing for transient construction workers during 1981 to 1983 will be required. Mobile homes and recreational vehicles are a major potential source of housing for these workers, however, adequate parks do not exist to accommodate these vehicles.
- Permanent Housing: A North County housing market impact will be created by new permanent employees at Vandenberg plus population generated indirectly by the economic stimulus of the project. The 1981 project-generated demand will be for 175 to 230 housing units and by 1985 this demand will increase by an additional 840 to 990 units.
- Archaeology: Much of Vandenberg contains numerous undisturbed archaeological sites. Preliminary ground surveys of the four candidate siting areas revealed no new surface archaeological finds. Adoption of the trench basing mode may unavoidably disrupt some sites. As required by law, these impacts will be mitigated by the development and implementation of a data recovery program.
- Candidate Siting Area Impacts: A comparison of the relative environmental impact potential of the conceptual facility layouts at each of the Candidate Siting Areas (CSAs) is provided on page ix. The facilities are configured to minimize environmental impact.

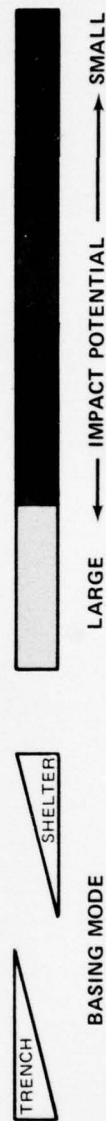
Project alternatives to flight tests at Vandenberg are:

- No project
- Reduction in the number of flight tests
- Flight tests at other locations
- Construction of the project at a different scale
- Project postponement

These alternatives do not meet the schedule or national security requirements for the program as proposed.

COMPARISON OF IMPACT POTENTIAL AT CANDIDATE SITING AREAS

EVALUATION PARAMETER	SHUMAN CANYON CSA (SHELTER ONLY)	SAN ANTONIO TERRACE CSA	BURTON MESA CSA	LOMPOC TERRACE CSA
TOPOGRAPHY				
SEISMIC HAZARD				
HYDROLOGY				
AIR QUALITY				
NOISE				
TERRESTRIAL BIOLOGY				
AQUATIC BIOLOGY				
ARCHAEOLOGY				
OIL EXTRACTION				
TRAFFIC				



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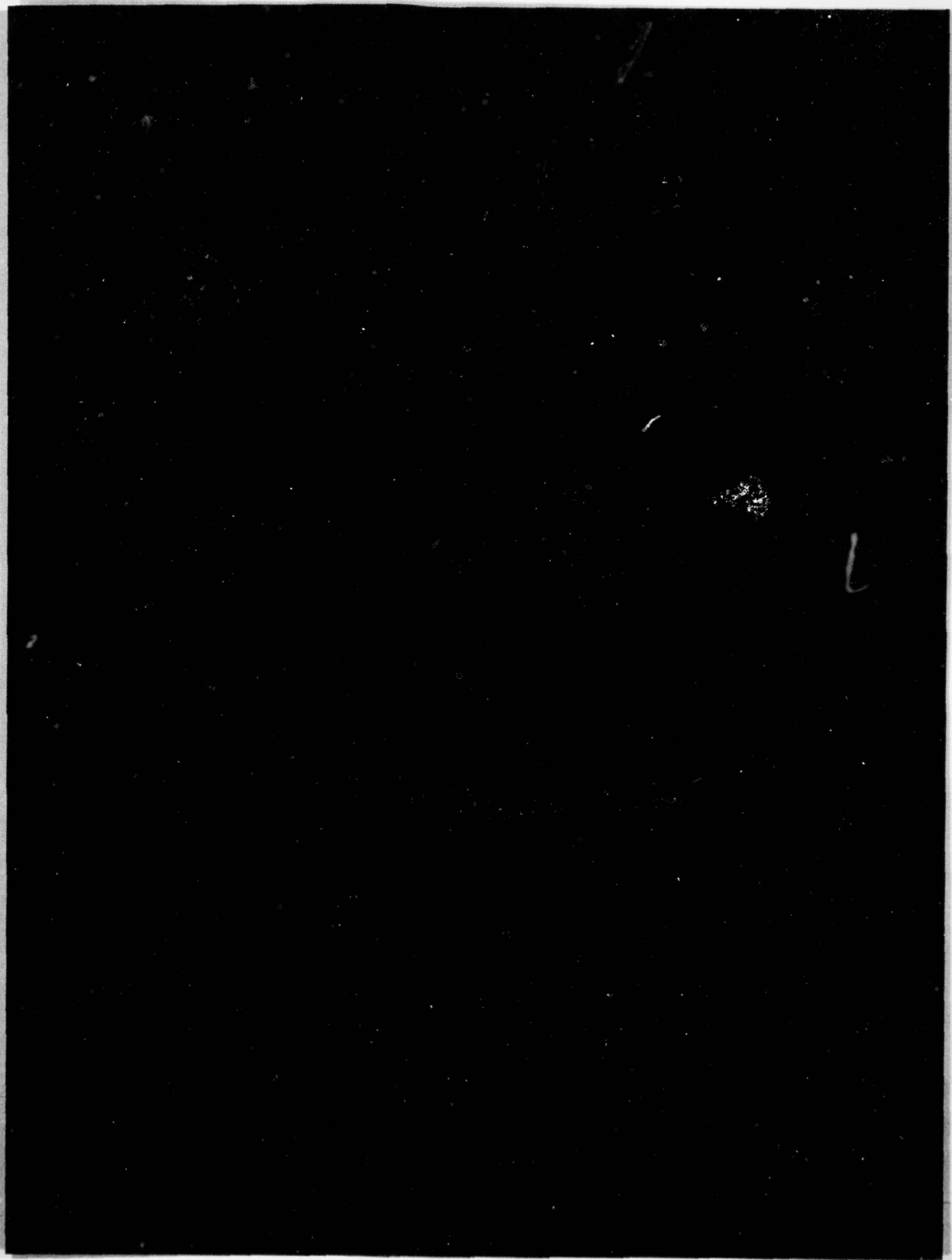
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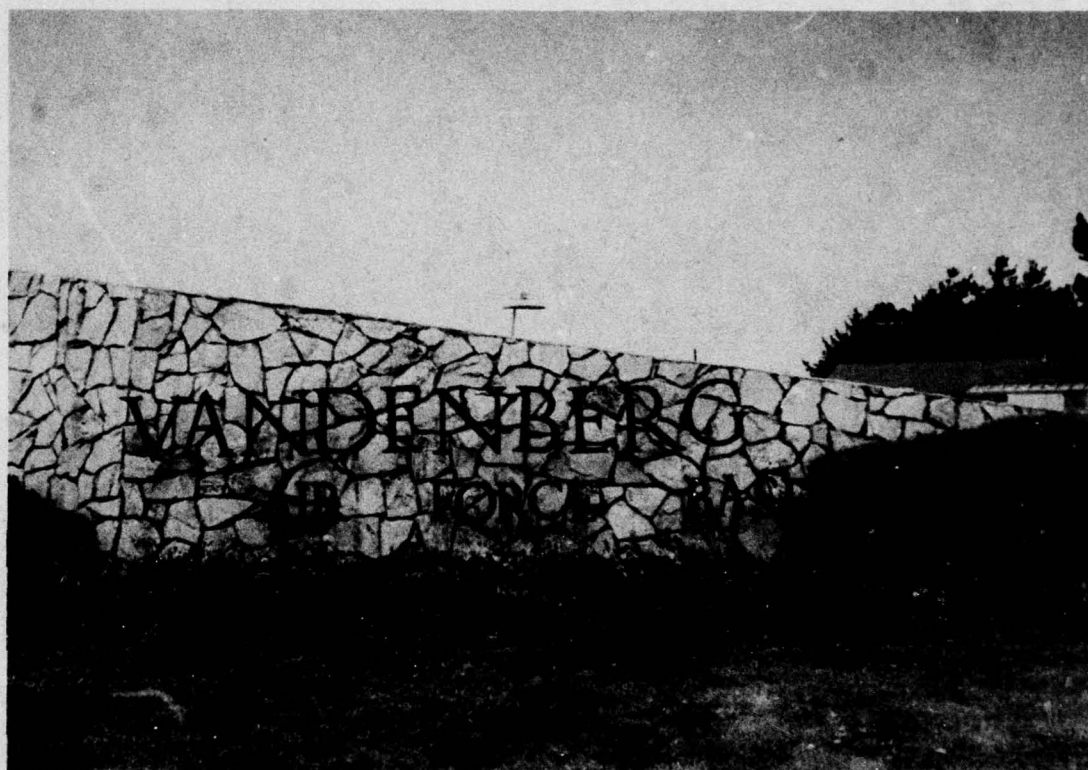
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Introduction

INTRODUCTION

As part of the Full-Scale Engineering Development program, tests of the full-scale missile system are required. These tests include placing a prototype missile in a portion of a full-scale prototype multiple aimpoint (MAP) facility and performing the various launch activities including prelaunch, breakout from the MAP location, launching of the missile, and inflight tests. These various missile tests will help to validate the performance of the integrated missile system and define additional engineering development required to meet the performance and cost objectives of the program. Since these tests include missile launches, the Air Force has determined that they should occur at its Western Test Range.

Vandenberg Air Force Base (VAFB) in Santa Barbara County, California, is the primary location for system level testing of the MX weapon system (Figure I-1). The test program will include ground tests and flight tests of the missile in conjunction with the basing mode selected for use in full-scale deployment of the weapon system.

Vandenberg lies on the south central California coast approximately 275 mi (442 km) south of San Francisco, 140 mi (225 km) northwest of Los Angeles, and 55 mi (88 km) northwest of Santa Barbara. The 98,400 acre (39,360 ha) base extends along approximately 35 mi (56 km) of Santa Barbara County coast and varies in width from 5 to 15 mi (8 to 24 km). Located on a relatively isolated section of the coast, with the Pacific Ocean comprising its entire western and southern boundaries, Vandenberg is ideally situated for its west coast missile and space launch missions.

The existing environment of Vandenberg is unique in many respects. This is partially due to its coastal location at the geographical division between central and southern California. This division is proximate to the natural boundaries between various physical and biological regions of the state. Figure I-2 depicts Vandenberg's geographic setting, including the nearby coastal counties and the Santa Barbara Channel Islands.

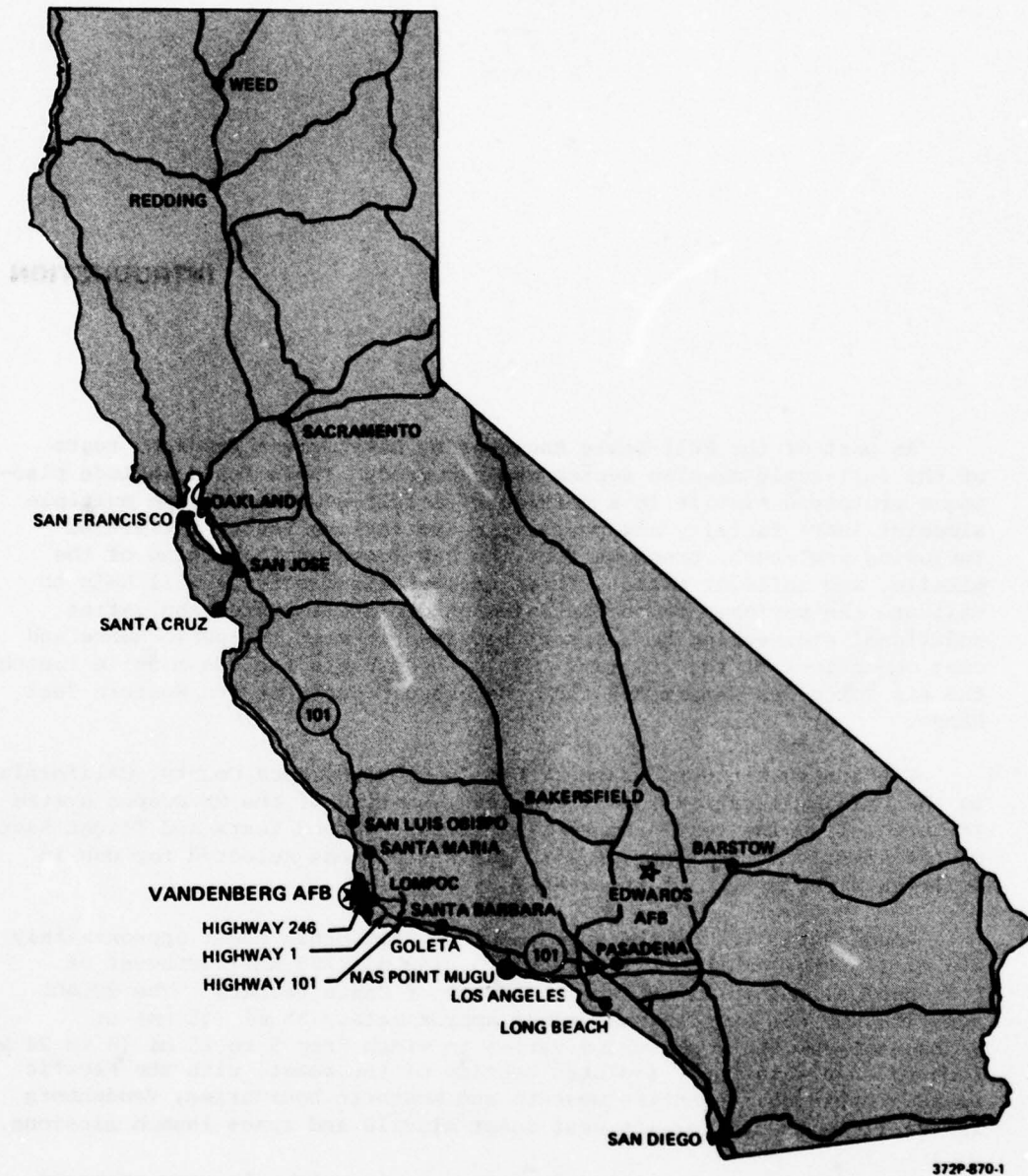
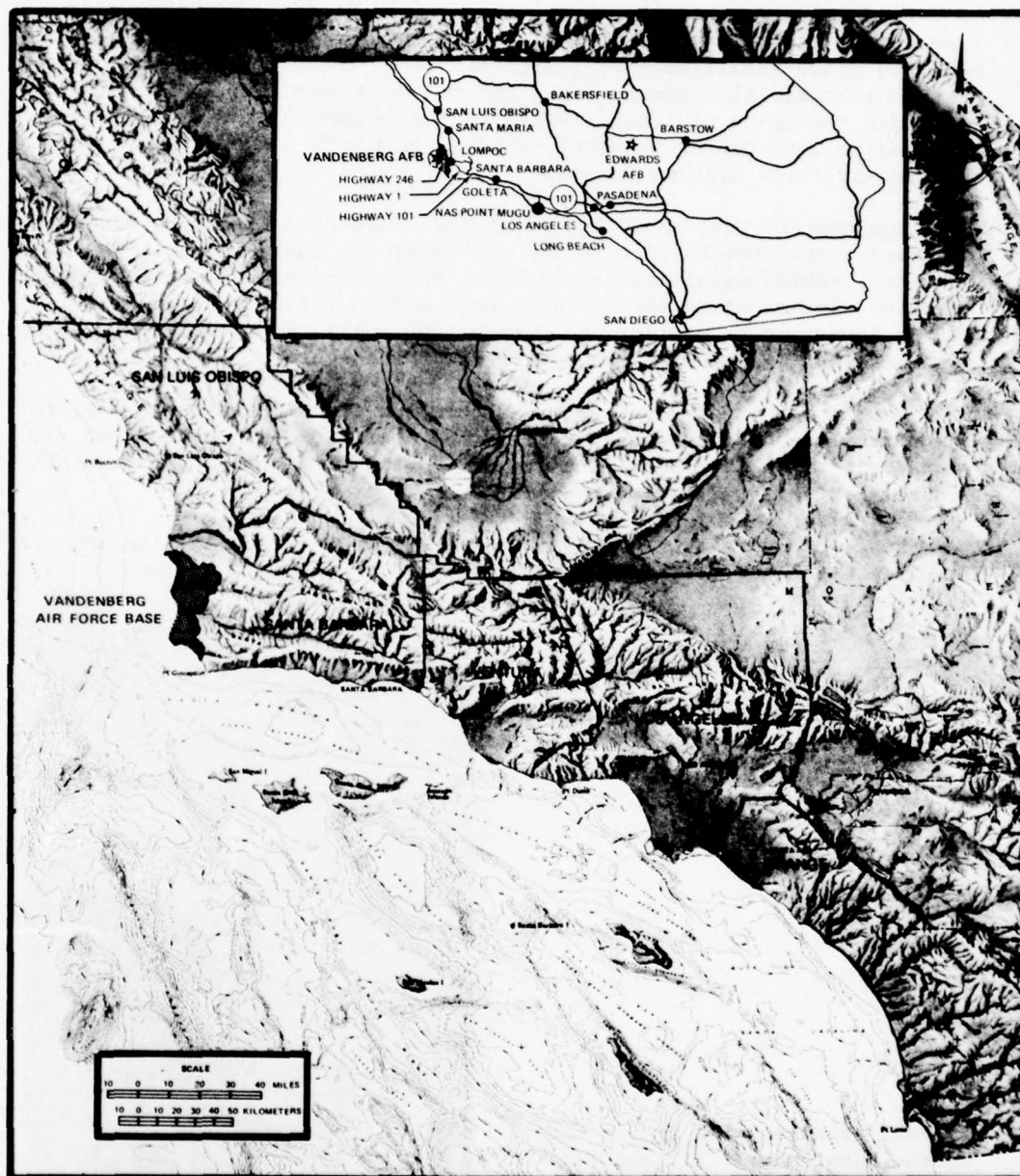


Figure I-1. Location of Vandenberg Air Force Base.



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Figure I-2. Regional geographic setting of Vandenberg AFB.

Vandenberg is the only site in the United States from which operational land based intercontinental ballistic missiles (ICBMs) and polar-orbiting space satellites are launched. It is the pioneer missile base of the Strategic Air Command (SAC) and the Headquarters of SAC's 1st Strategic Aerospace Division (1STRAD). The primary tenant is the Space and Missile Test Center (SAMTEC), which operates the Western Test Range for the Air Force Systems Command.

The Western Test Range begins at the Vandenberg coastline and extends westward across the Pacific to the middle of the Indian Ocean. As range operator, SAMTEC maintains an intricate network of electronic and optical tracking systems along the Pacific coast and on islands, ships, and planes downrange to monitor and control the ballistic missiles and space boosters that are launched by a variety of range users.

Vandenberg is the busiest launch complex in the free world. Since the first launch in December 1958, it has averaged over 70 launches per year for a total of approximately 1,400. Predominant have been the SAC Minuteman ICBMs (523 launches as of December 1977).

Space boosters launched from Vandenberg have varied in size and shape from the huge Titan IIID with its 2,870,000 lb (12,770,000 N) of initial thrust to the needle-thin Scout. Since February 1959, such

MX test launches will be similar to the Minuteman I, II, and III tests and operational exercises currently performed on the base. Minuteman launches comprised over 60 percent of all VAFB launches during 1977.



boosters have placed over 450 unmanned satellites into polar orbit, providing maximum coverage of the globe for outer atmosphere experiments, weather reporting, earth resources technology, and myriad other purposes.

More than 50 different types of launch vehicles (ballistic and space) have been employed at Vandenberg over the years and, in the next decade, the Space Transportation System, more commonly called the Space Shuttle, is scheduled to be added to the list. The Space Launch Complex #6 (SLC-6) will be modified especially for this manned space mission. With the advent of the Space Shuttle Program and the MX Program, Vandenberg will become America's most active and diversified aerospace center.

The currently active launch facilities at Vandenberg (including SLC-6) are listed in Table I-1, along with each facility's launch capability, launch activity, number of launches in fiscal year 1977, and command ownership. Other facilities with a significant number of launches were SLC-4 (East and West), and the Bomarc facilities. The SLC-4 facilities launch the Titan III booster for orbital space missions, and the Bomarc facilities are operated by the Navy for training purposes. The Bomarc missiles are fired as naval targets in the Western Test Range.

Table I-1. Active launch facilities at Vandenberg.

SITE DESIGNATION	LAUNCH CAPABILITY	LAUNCH ACTIVITY	LAUNCHES IN FY 1977	COMMAND OWNERSHIP
MMLF (12 silos)	Minuteman	Weapon System Test	20	SAC/AFSC
395C	Titan II	Operational Test	0	SAC
SLC-2W	Thor/Delta	Orbital Space	0	NASA
SLC-3 (E and W)	Atlas	Orbital Space	1	AFSC
SLC-4 (E and W)	Titan III	Orbital Space	4	AFSC
SLC-5	Scout	Orbital Space	0	NASA
SLC-6	Space Shuttle	STS	0	AFSC
SLC-10W	Thor	Orbital Space	1	ADC
BOMARC (1 and 2)	Bomarc	Navy Targets	7	U.S. Navy

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Abbreviations:

ADC - Aerospace Defense Command
 AFSC - Air Force Systems Command
 MMLF - Minuteman Launch Facility
 NASA - National Aeronautics and Space Administration
 SAC - Strategic Air Command
 SLC - Space Launch Complex
 STS - Space Transportation System

The approximate locations of each of these launch facilities are shown in Figure I-3. Also shown are the locations of the four MX candidate siting areas (CSAs) addressed in this report. The location of the project at Vandenberg is presently expected to be within one of the CSAs, which are described in Section 1. The various ground facilities and roads have been conceptually laid out on each of the CSAs for purposes of determining site-specific impacts.

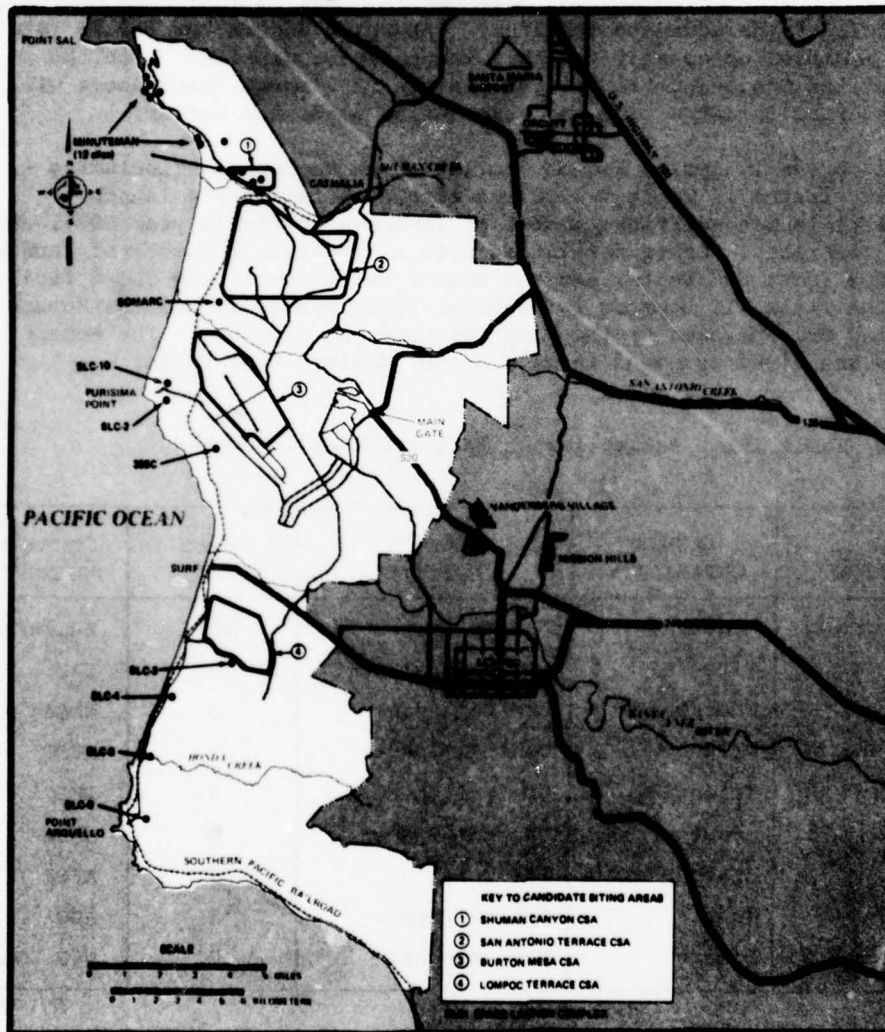
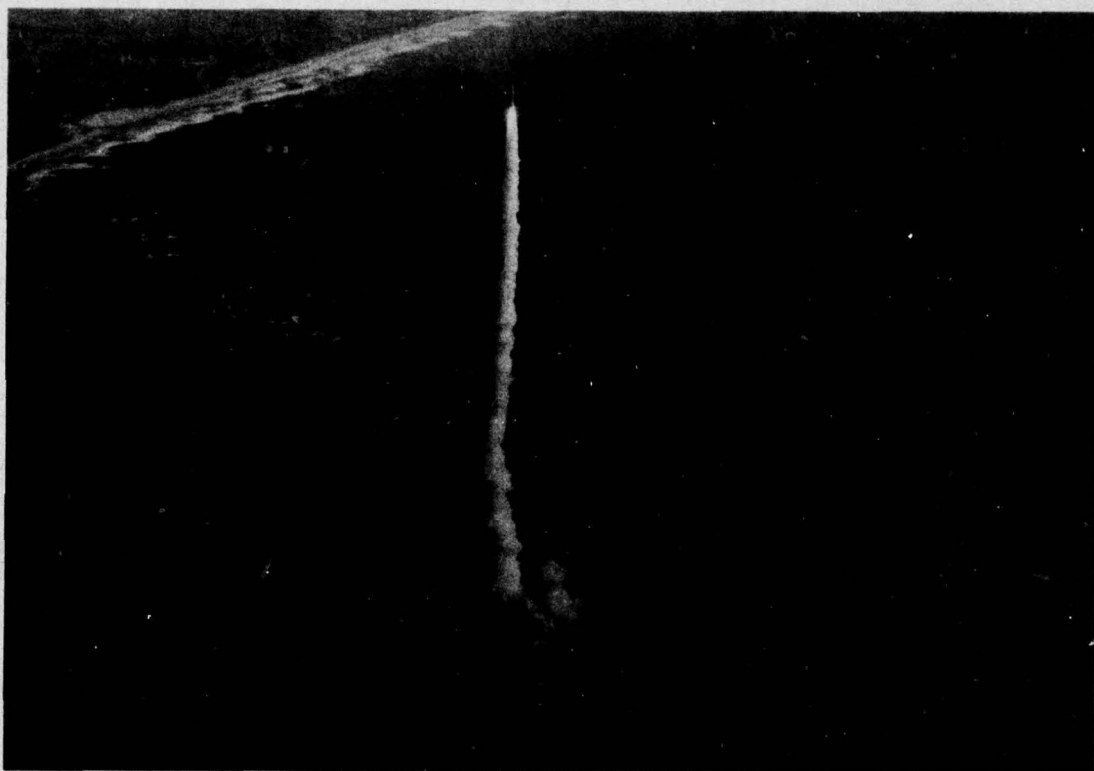


Figure I-3. Locations of active existing missile launch facilities and proposed MX Candidate Siting Areas at Vandenberg AFB.



Project and Environment

1

THE PROJECT AND THE ENVIRONMENT

This section of the environmental report describes the MX weapon system test programs and associated construction at Vandenberg in sufficient detail to permit assessment of the potential adverse and beneficial environmental effects. Also described in this section is the existing environment of the base and surrounding region which may be affected by implementation of the project.

1.1 DESCRIPTION OF THE PROPOSED PROJECT

MX Weapon System Test Programs (1.1.1)

The Missile and Basing Mode Development Test Programs comprise the developmental testing of MX components and systems. This testing phase includes approximately 20 flight tests of the missile from an operationally configured basing mode. The Strategic Air Command (SAC) Operational Test Program (OT) commences after completion of the development tests and continues for the life cycle of the weapon system.

System level tests at Vandenberg will include ground tests and flight tests of the MX systems in conjunction with the basing mode selected for use in full-scale deployment of the weapon system.

The test program contains two developmental test programs and an operational test program. These programs and their projected dates of activity are as follows.

Missile Development Test Program (1.1.1.1). The primary objective of the Missile Development Test Program is the developmental and interim operational test and evaluation of the missile and canister systems. This process includes tests and analyses necessary to support subsystem development and initial flight tests.

Missile development tests which are proposed to be conducted at Vandenberg are listed in Table 1-1. Test activities will be refined as the program is further defined and as detailed development plans are prepared by associated contractors.

The portions of the Missile Development Test Program to be conducted at Vandenberg include the following activities:

- facilities construction
- equipment installation and checkout
- hardware processing
- handling
- communications
- missile ejection tests (2)

The missile ejection tests (Stage 0) will be conducted to acquire canister design data. The first missile ejection test will be inert. The second missile will have a short burn (≈ 7 seconds) first stage with all other stages inert. Clas 1.1 propellant will be used in Stage 1. Both of these missiles are planned to land within Vandenberg or the near-shore area away from personnel-occupied areas. The missiles will be recovered after the tests.

Basing Mode Development Test Program (1.1.1.2). The primary objective of the MX Basing Mode Development Test Program is the developmental and interim operational test and evaluation of the MX basing mode hardware, software, and facilities and the integration of the missile with these equipments and facilities.

Two different basing mode options are currently under consideration: trench and shelter. Since the MX basing mode has not been selected, current planning specifies only that the basing mode development schedule at Vandenberg include the following activities:

- basing mode construction
- assembly and checkout
- vehicle train integration
- weapon system integration
- missile flight tests

Approximately 20 missiles will be launched and flown in the Western Test Range during 1983 to 1987. The maximum launch azimuth band will be

Table 1-1. MX missile development tests.

MISSILE DEVELOPMENT TEST	TEST LOCATION
Aerospace Vehicle Equipment Fit Checks	VAFB (ITF)
Umbilical Retraction Test	VAFB
MGCS Transportation and Handling Test	VAFB (ITF)
IFSS Transportation and Handling Test	VAFB
Canister Transportation and Handling Test	VAFB
VAFB Stage I Transportation and Handling Test	VAFB
VAFB Stage II Transportation and Handling Test	VAFB
VAFB Stage III Transportation and Handling Test	VAFB
VAFB Stage IV Transportation and Handling Test	VAFB
Reentry System Transportation and Handling Test	VAFB
Launch Complex Assembly and Launch Verification Test	VAFB
Missile Ejection Tests	VAFB
Reentry System Integration/Compatibility and Processing Test	VAFB (ITF)
Missile Guidance System Processing Test	VAFB
IFSS Processing Test	VAFB (ITF)
Stage IV Processing Tests	VAFB
Stages I, II, and III Flight Processing Tests	VAFB (SMF)
Missile Interface Test	VAFB
Canister/Launch Complex Refurbishment Test	VAFB
AVE/Laboratory Integration/Compatibility Tests	VAFB (ITF)
Missile Ejection Test (Short Burn)	VAFB
Ground Test Missile Launch Complex Test	VAFB

372T-3001

Abbreviations:

AVE—Aerospace Vehicle Equipment
 IFSS—Instrumentation and Flight Safety System
 ITF—Integrated Test Facility
 MGCS—Missile Guidance and Control System
 PAB—Payload Assembly Building
 SMF—Stage Modification Facility

between 217° (southwest) and 290° (west-northwest) with most flights launched in the vicinity of 267° (west). Figure 1-1 depicts these launch azimuths as they would appear if they originated from the most southerly candidate siting area at Vandenberg. From this figure, it can be inferred that the closest possible approach of a missile to San Miguel Island (the most westerly of the Santa Barbara Channel Islands) would be more than 30 mi (48 km). A missile launched along the primary launch azimuth of 267° would never approach nearer to San Miguel Island than the actual launch point 42 mi (67 km). If a more northerly candidate siting area is selected, these distances will be greater.

The missile stages, which will drop off into the ocean during the flight, will not be recovered. The reentry vehicles will be targeted into four separate target areas in the Western Test Range:

- Kwajalein Lagoon in the Marshall Islands
- The broad ocean area 800 mi (1,280 km) northeast of Kwajalein
- The broad ocean area 400 mi (640 km) southwest of Kwajalein
- The broad ocean area 1,100 mi (1,760 km) southwest of Kwajalein

SAC Operational Test Launch Program (1.1.1.3). Following completion of the MX development test programs, the MX facilities will be turned over to the Strategic Air Command (SAC). They will be used by SAC as a training facility for personnel who will operate the MX operational base at a yet-to-be-determined location. It is expected that the SAC program at Vandenberg will average approximately 10 operational test launches per year throughout the life of the weapon system.

Description of MX Support Facilities (1.1.2)

Tentative MX test and support facility needs at Vandenberg have been determined from a functional analysis of development test requirements. The final definition of construction requirements will be accomplished during the early phases of full-scale development to support the Military Construction Program (MCP) funding cycle. The following facilities have been identified for planning purposes:

- A rail transfer facility to unload/load test hardware
- A mechanical maintenance facility to prepare and refurbish the canister system and heavy components
- An integrated test facility conceived as a complex providing:
 - launcher control sites
 - laboratory control sites
 - laboratories (guidance, telemetry, flight safety, instrumentation, etc.)

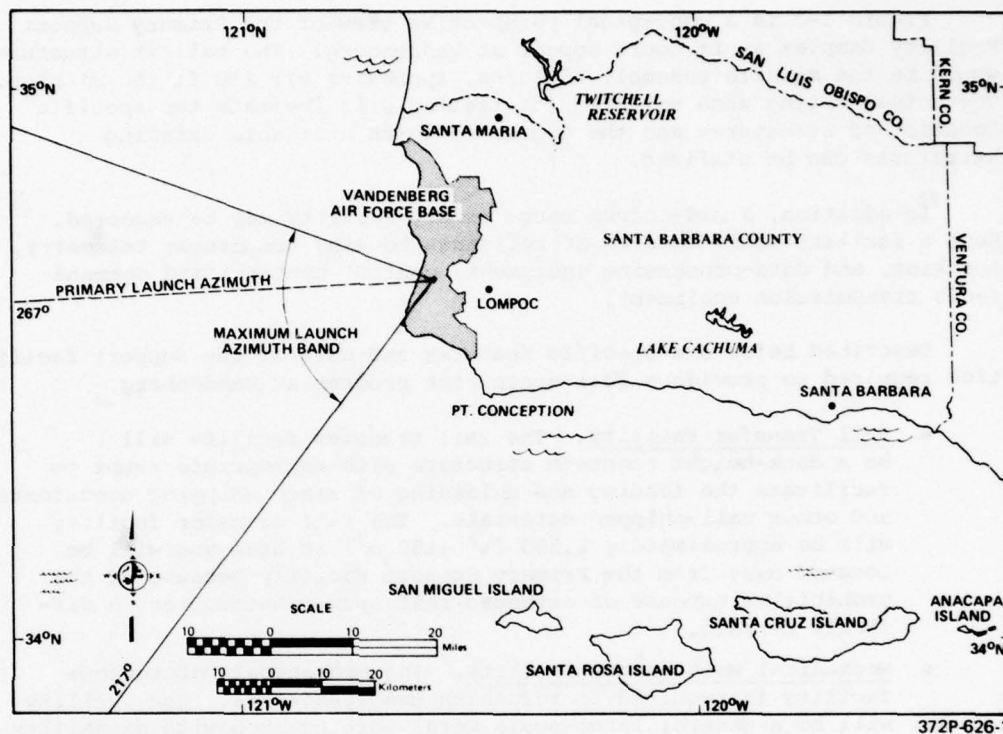


Figure 1-1. MX launch azimuths from the southernmost candidate siting area at Vandenberg AFB.

- radio repeater systems
- mockup areas
- A payload assembly building (PAB) for reentry system processing
- Stage modification facilities (3) for installation and checkout of telemetry and flight safety hardware for Stages I, II, and III
- Stage storage pads (3) to provide storage for Stages I, II, and III
- Stage IV processing facility
- A missile assembly building (MAB) for buildup of the MX in the operational canister
- Basing mode facilities (trench or shelter)

Figure 1-2 is a conceptual perspective view of the Primary Support Facility Complex as it could appear at Vandenberg. The tallest structure would be the missile assembly building, approximately 180 ft (60 m) high. The actual siting area selected for testing will indicate the specific location of structures and the degree to which available existing structures can be utilized.

In addition, a mid-course range safety facility may be required. Such a facility would consist of buildings housing computers; telemetry, tracking, and data-processing equipment; control centers; and command radio transmission equipment.

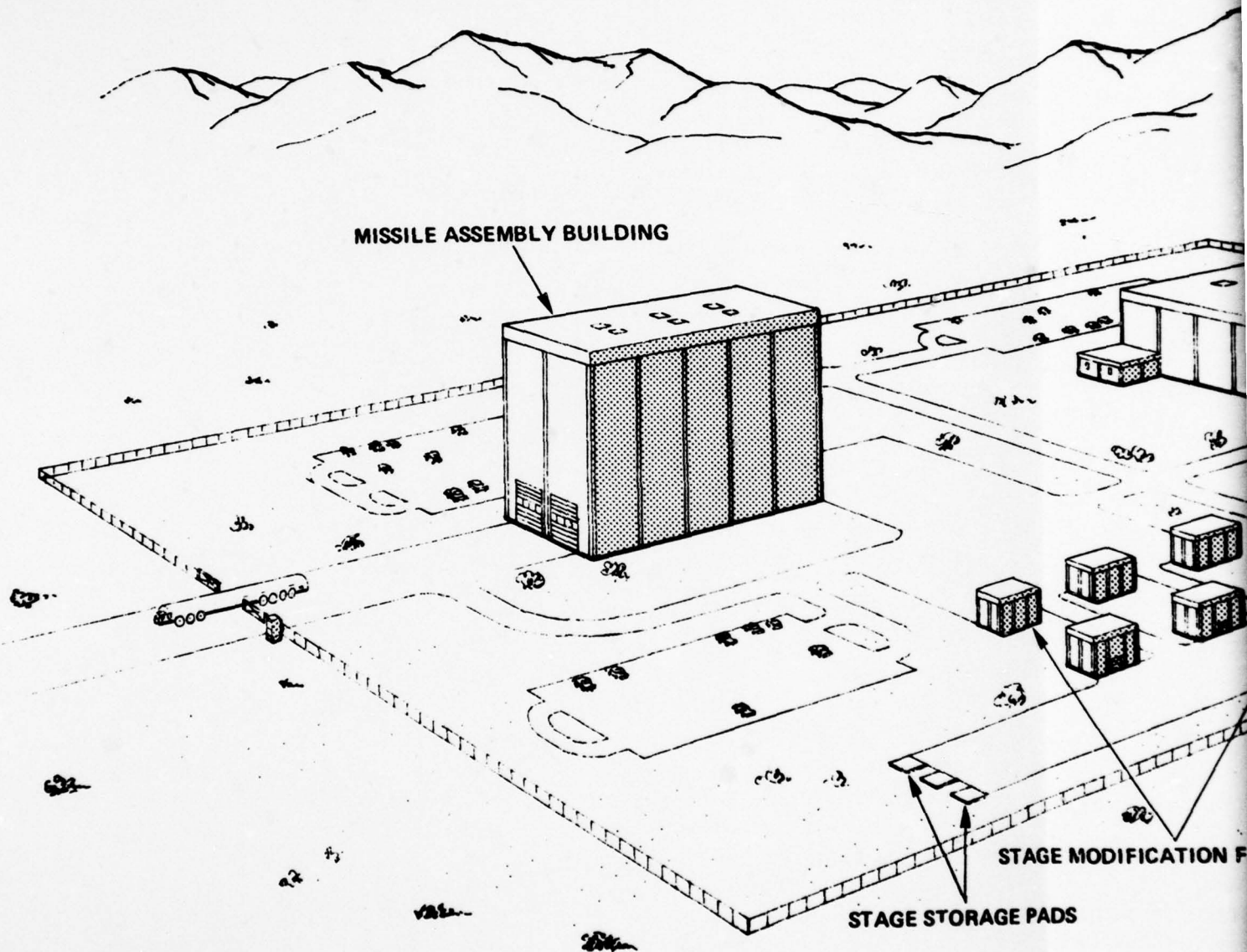
Described below are specific features and uses of the support facilities required to provide a full-scale test program at Vandenberg.

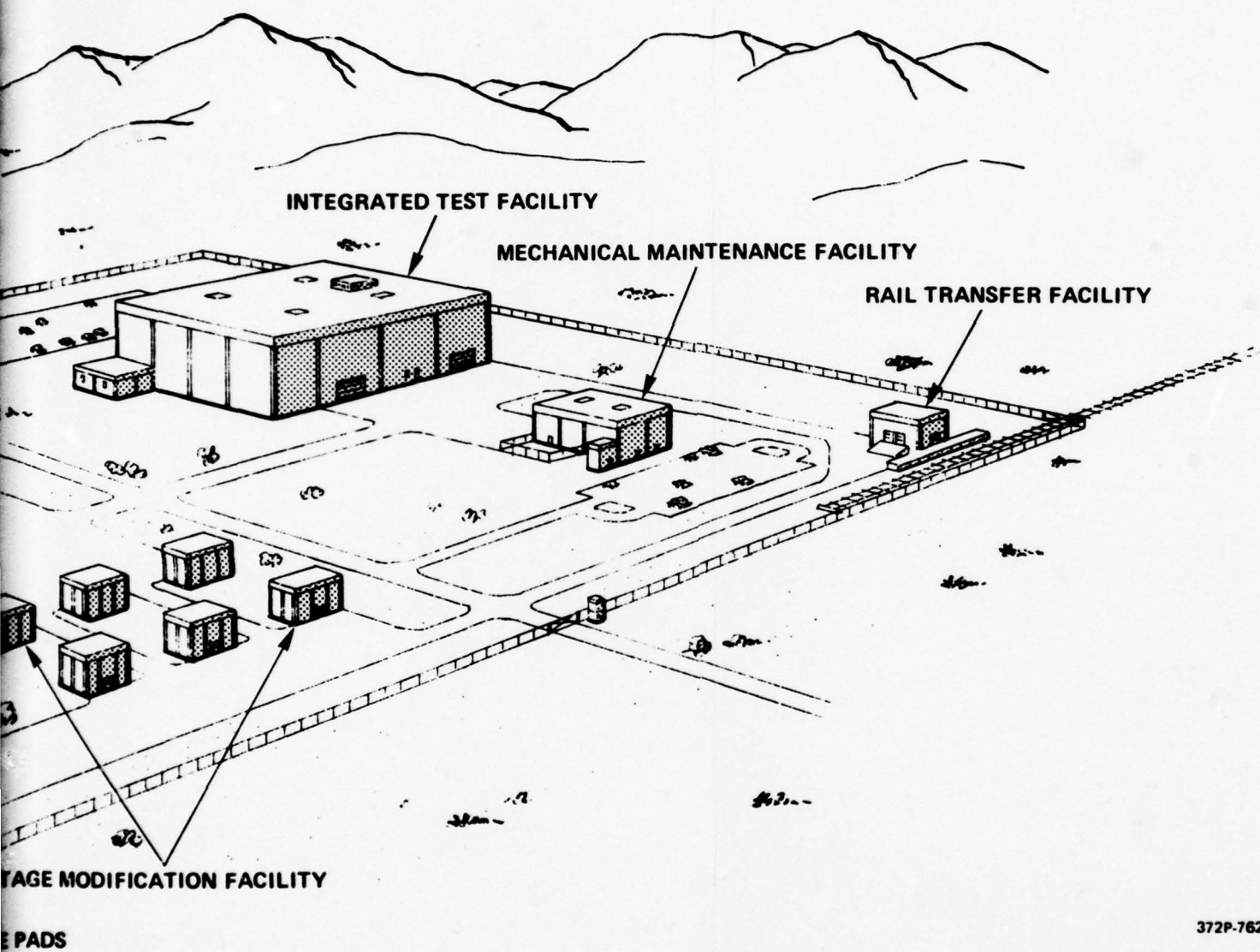
- Rail Transfer Facility. The rail transfer facility will be a dock-height concrete structure with appropriate ramps to facilitate the loading and unloading of stage shipping containers and other rail-shipped materials. The rail transfer facility will be approximately 1,500 ft² (150 m²) in area and will be located away from the Primary Support Facility because of the prohibitive expense of extended rail spur construction in difficult terrain.
- Mechanical Maintenance Facility. The mechanical maintenance facility is required to refurbish used canisters. The facility will be a general large-scale metal working shop with capability for welding, cleaning, grinding, etc. It will be designed to accommodate two operations simultaneously and to provide storage for refurbished canisters. This facility will include 10,000 ft² (930 m²) of fenced yard equipped with a 50-ton crane (45.4 tonnes) approximately 200 ft² (20 m²) office space, and three 2,000 ft² (186.0 m²) high bay (20 ft, 6.1 m) storage areas. The building will be a slab on grade, steel frame structure with metal siding and long span roof deck. It is anticipated that this will be a permanent structure to be used for maintenance of canisters from the MX operational base throughout the life of the MX weapon system.
- Integrated Test Facility. The integrated test facility is proposed to be a large multipurpose structure designed to house the following functions:
 - Aerospace vehicle equipment (AVE) processing lab
 - AVE compatibility lab
 - Radio frequency (RF) test chamber
 - Ground instrumentation operations and maintenance (O&M) lab
 - Inflight safety system monitor and control facilities (3)
 - Launch control center
 - Weapon system integration lab—software development
 - Missile mockup

MISSILE ASSEMBLY BUILDING

STAGE MODIFICATION F

STAGE STORAGE PADS





372P-762

Figure 1-2. Perspective View of a
Conceptual Primary Support
Support Facility Complex.

Missile Flight Testing III-13

- Ground test missile (GTM) storage
- Data processing, storage, and display
- Cable patch
- Intersite communications
- Storage
- Offices

It is anticipated that this facility will include approximately 55,000 ft² (5,110 m²) of which 25,000 ft² (2,322.5 m²) is high bay (50 ft) (15 m) with a 50-ton (45.4 tonnes) crane coverage provided for approximately one-third of the area. Also included will be 15,000 ft² (1,393 m²) of laboratory space and 15,000 ft² (1,393 m²) of office space. Certain areas of this facility will require sophisticated environmental control, RF shielding, underslab utility distribution, equipment cooling, and other special features. This structure will be a combination of steel frame and reinforced concrete construction.

- Payload Assembly Building. The payload assembly building is required to process reentry systems. This function requires approximately 5,000 ft² (465 m²) of 50-ft (15 m) high bay served by a 5-ton (4.5 tonne) overhead crane. Current planning indicates that existing facilities at Vandenberg may be available which meet this requirement. This function may be remote from the launch area and existing structures have been identified as potential sites. The extent of construction activity associated with the required modification cannot be determined at this time.
- Stage Modification Facilities. The stage modification facilities provide for the installation and checkout of the instrumentation and flight safety system (IFSS). These facilities consist of three 1,000-ft² (92.9 m²) stage modification structures and three 1,000-ft² (92.9 m²) storage facilities. The modification structures require 20 ft (6.1 m) clear height inside. These facilities may not be immediately adjacent to the launch area and will be sited to satisfy the quantity-distance criteria for propellant storage and handling. These facilities will be of reinforced concrete construction with appropriate safety features incorporated into the design.
- Stage Storage Pads. Exterior pads are proposed for storage of stages I, II, and III. Three 700-ft² (65.1 m²) reinforced concrete pads with provisions for AC power will be required. The pads will be located within a controlled access area and separated by proper distances for the quantity-distance criteria for propellant storage. The storage pads would preferably be located near the stage modification area and missile assembly building.
- Stage IV Processing Facility. The Stage IV processing facility will be used for processing of Stage IV, including installation of antennae and flight termination ordnance. This structure will occupy 5,000 ft² (464.5 m²) and will have a 20-ft (6.1 m) clear

height. It will be served by a 5-ton (4.5 tonne) overhead crane.

- Missile Assembly Building. It is proposed to construct the missile assembly building near the launch area. It will be designed to process two missiles at a time. This function will require 20,000 ft² (1,856 m²) of floor space with a clear height of 170 ft (51.8 m). The missile assembly process requires a 150-ton (136 tonne) traveling crane. This structure will be slab on grade, steel frame, metal siding, and long span roof deck. Special features include large hangar-type doors.

Description of MX Basing Mode Facilities (1.1.3)

It is anticipated that the basing mode test facilities will include a fully operational installation of one of three shelter modes or of the trench mode. The installation will be limited to the requirements of the *Integrated Test Plan*. The trench basing mode test program would require approximately two, 2-mi (3.2 km) sections of hybrid trench. The shelter or pool basing mode test program would require approximately three horizontal or vertical shelters or pools, depending on the basing mode. Various facilities will also be required for support of the selected option.

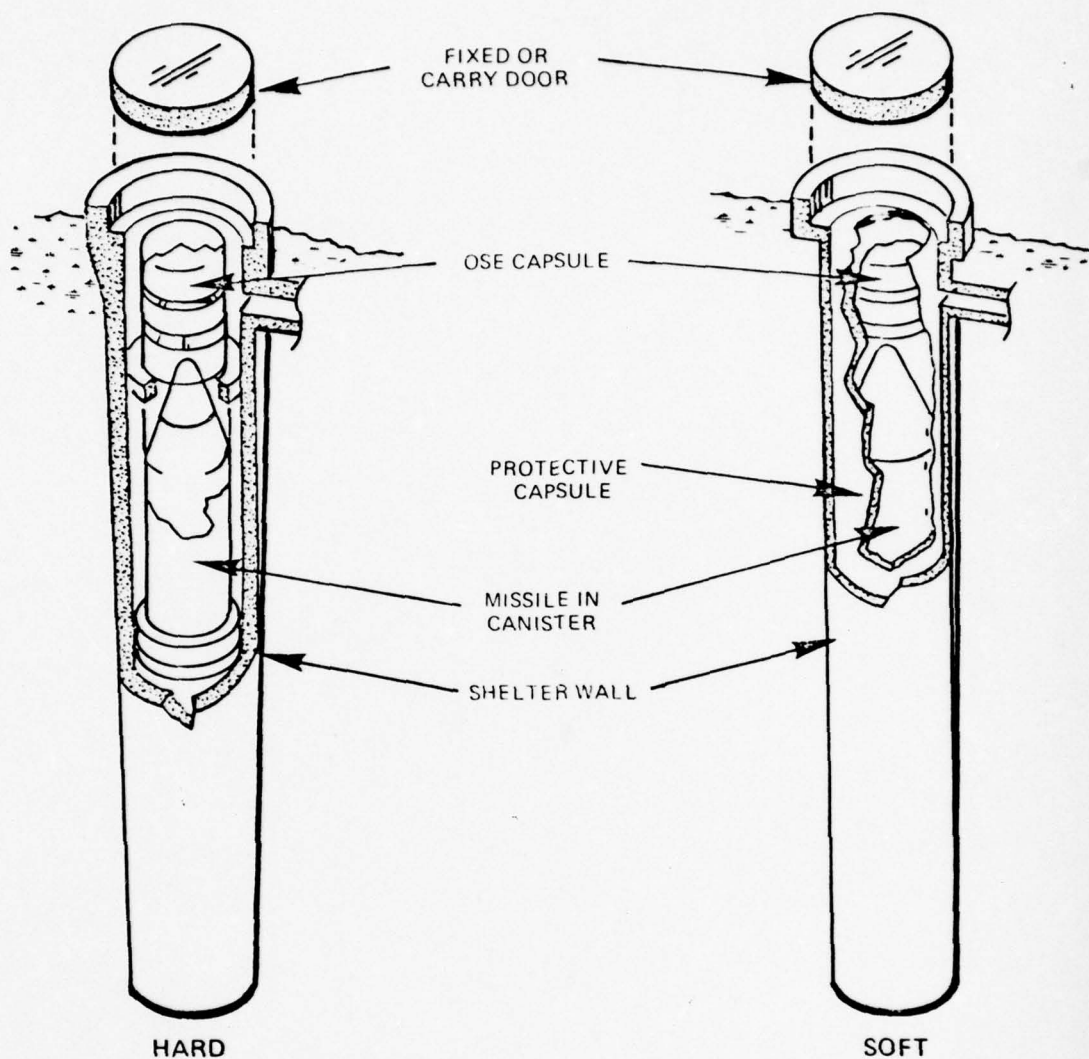
Shelter/Pool Options (1.1.3.1). Three basic discrete aimpoint options are currently under consideration as candidate basing modes:

- vertical shelter
- horizontal shelter
- pools

Each is briefly described below.

Vertical Shelters. Figure 1-3 presents the details of the hard and soft vertical shelters. A typical hard vertical shelter would be approximately 125 ft (38 m) deep, with an inside diameter of 13 ft (4 m) and a 9-in. (23 cm) thick wall. A 2-ft (60 cm) thick reinforced concrete floor would support the loads imposed by an emplaced missile, and thicker walls would be provided at the top to withstand blast loads and support the blast door. A larger inside diameter would be necessary for the soft shelter sub-option to accommodate the protective capsule that would surround the canisterized missile, and correspondingly thinner shelter walls would be provided.

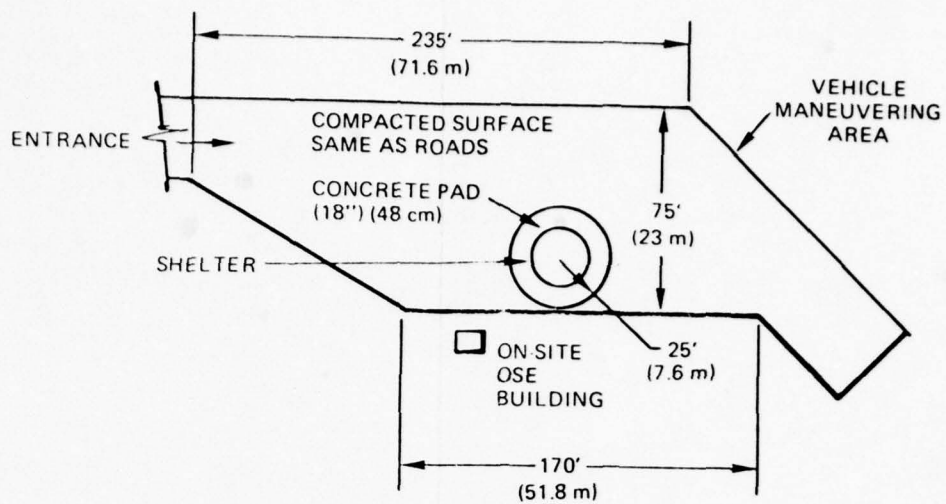
Special transporter vehicles for vertical shelter options would be designed to carry the missile horizontally, erect it over the shelter, and insert the missile into place.



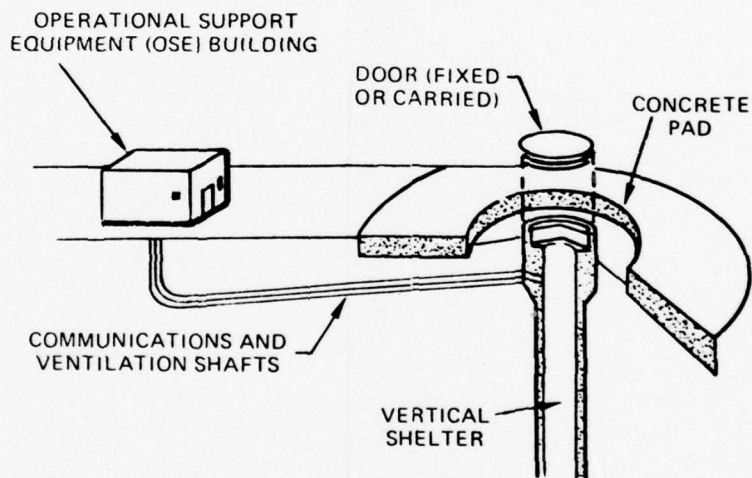
HARD AND SOFT VERTICAL SHELTER ELEMENTS

FEATURES:

- POTENTIALLY LEAST COST
- BEST KNOWLEDGE OF DESIGN CHARACTERISTICS:
- GREATER CONFIDENCE IN HARDNESS COULD LEAD TO REDUCED SPACING, USE OF LAND
- CARRY-DOOR/FIXED-DOOR OPTIONS APPLY



HARD FACILITY SITE PLAN



CONCEPTUAL ELEMENTS

372P-718-2

Figure 1-3. Details of the vertical shelter.

The shelter site includes:

- A maneuvering area for the transport vehicles
- A reinforced-concrete vertical shelter for the canisterized missile with its onboard operational support equipment (OSE)
- A circular concrete pad around the vertical shelter entrance, to carry the loads associated with missile/OSE emplacement and removal
- A "soft" operational support equipment (OSE) building, which provides ventilation, onsite OSE, and related functions for peacetime operation (Connections to the shelter are through hardened buried structures to prevent damage to in-shelter equipment by air attack.)

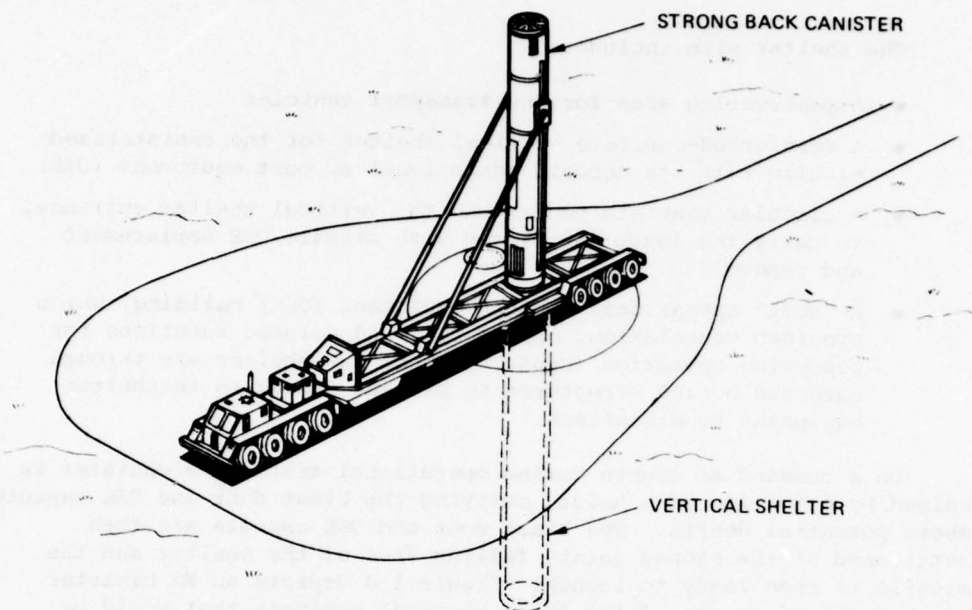
On a command to launch during operational tests, the canister is raised by actuation of a hoist, carrying the blast door and OSE capsule above potential debris. The blast door and OSE capsule are then jettisoned at the sloped joint, falling free of the shelter and the missile is then ready to launch. Figure 1-4 depicts an MX canister being emplaced at one of the three vertical shelters that would be constructed at Vandenberg under this option.

Horizontal Shelters. The horizontal shelter option consists of five basic elements:

- A buried reinforced concrete cylinder with a hemispherical inner end, and a flat floor to carry the missile launch vehicle. The entire structure is approximately 195 ft (60 m) long
- A blast door that protects the shelter entrance against attack effects in operational bases and can be opened against simulated attack-induced debris
- A level reinforced concrete apron (below ground level) in front of the shelter, for missile ingress and egress
- A reinforced concrete downramp to provide access to the shelter from the road network
- Road network to permit movement of the missiles between shelters, provide access to the primary support area, and facilitate movement of security patrols

Three variants of the horizontal shelter are under consideration:

- The basic plowout form. For launching, the portion of the launch vehicle carrying the missile emerges from the shelter and plows through attack-induced debris before the missile is erected and fired.



372P-809

Figure 1-4. Conceptual drawing of MX canister being emplaced in a vertical shelter.

- The drive-out, or "loading dock," variant. The bottom of the shelter proper is approximately 9.5 ft (2.9 m) above the level of the concrete apron from which the missile is emplaced. The transport vehicle does not enter the shelter, so the shelter diameter (and cost) can be reduced as compared with the other variants. Moreover, since the shelter is above the level of the concrete apron, the emerging missile does not encounter attack-induced debris, and both the problems of door opening and vehicle travel through such debris are eliminated.
- The "breakout" variant. This configuration is similar to a section of buried trench that acts as a shelter. For launching, the missile breaks out through the structure and earth overburden to its firing position, as in the buried trench concept. Both the conventional shelter and loading dock concepts are applicable to this variant.

In addition to the possible variations in horizontal shelter design, there are also two possible variations in the protective door concept. In the basic fixed-door plowout concept, each shelter is equipped with a

heavy blast door, which is opened by permanent equipment installed in the shelter itself. As an alternative, the blast doors can be carried from shelter to shelter with the missile, so that only those shelters that require a heavy and expensive blast door are so equipped. (The others are fitted with deceptive shields.) In normal operation, the blast doors are carried, removed, and emplaced by the missile transport vehicle. Where emergency egress is required for a launch, the blast door is either plowed out by the missile launch vehicle or, in the loading dock concept, pushed out of place by the emerging missile to fall into the space provided for attack-induced debris. Figure 1-5 depicts the loading dock missile being emplaced from its transport vehicle.

More complex vehicles with heavier loaded weights, and more weight-capable roads are required with carry-door vs. fixed-door shelters. However, the need for massive and expensive blast doors with their associated actuation mechanisms at every shelter is eliminated, potentially resulting in net cost reductions.

Pools. The missile with its on-board operational support equipment would be carried in a pressurized, waterproofed capsule and rested on the bottom of a slope-sided pool. In this pool option, the water is contained by a suitable liner and the missile launch platform (MLP) is emplaced by a platform transporter (PT) that enters the pool on a concrete ramp. The pool proper is excavated below ground level, with the

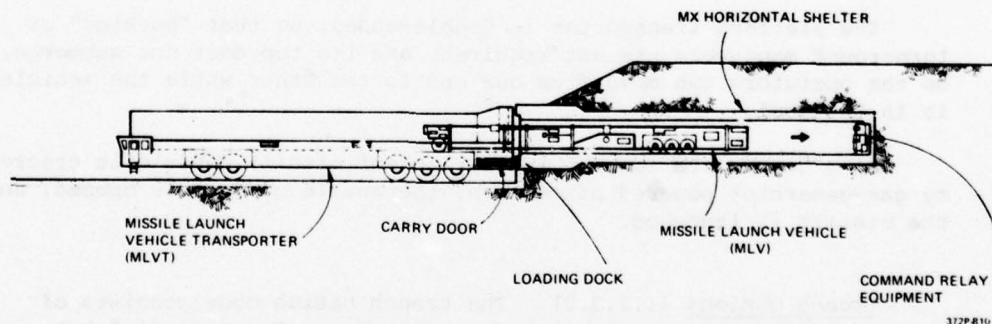


Figure 1-5. Conceptual drawing of a loading dock shelter vehicle emplacing the MX canister and launch vehicle. Note that this is the carry door vehicle which transports the heavy protective door, leaving only a deceptive shield over the shelter opening.

excavated material used to construct a dam-like berm at its periphery to minimize earth-handling requirements. A reinforced-concrete ramp, 30 ft (9 m) wide and 12 in. (30 cm) thick, provides access to a similar level pad on the bottom of the pool for emplacement of the missile launch platform.

The sloped sides inside the pool are waterproofed with a plastic liner. The pool is 24 ft (7.3 m) deep and is filled to a depth of 21 ft (6.4 m), requiring approximately 2.2 million gallons (8,000 m³). An above-ground Operational Support Equipment building provides on-site command, control and communications equipment. A metallized plastic pool cover, approximately 2 ft (60 cm) below the surface, provides protection against both visual and radar observation.

The entire aimpoint facility, except for a buried antenna, is enclosed by a fence adequate to prevent roving animals from activating the intrusion alarms and to minimize the amount of debris that blows into the pool.

Special transport vehicles would be required. To emplace the missile launch platform, the entire platform transporter enters the pool along the concrete ramp provided, to a position on the level concrete pad at the pool bottom. If the transporter is loaded, sufficient water is taken aboard so that the water level in the pool does not change by more than the amount associated with entry of an unloaded unit. The missile launch platform is then emplaced, and a door at the end of the PT opened to provide clearance for drive-out over the MLP. The vehicle is then driven (and winched) out of the pool, to move to its next position.

The platform transporter is double-ended, so that "backing" or turnaround maneuvers are not required, and its top does not submerge, so the operators can move from one end to the other while the vehicle is in the pool.

On a command to launch, the waterproof missile capsule is erected by gas-generator powered activators, the muzzle closure is opened, and the missile is launched.

Trench Options (1.1.3.2). The trench basing mode consists of an array of buried concrete tubes or trenches. Two 2-mi (3.2 km) sections are planned for the test program. The missile train used for operational testing would consist of two blast plugs and a transporter launcher with its canisterized missile (Figure 1-6).

At the entrance to each trench is a trench support building, connected to a primary support area by a road. The trench support building permits limited maintenance activities to be carried out without revealing that the assigned missile is out of service. The road network allows

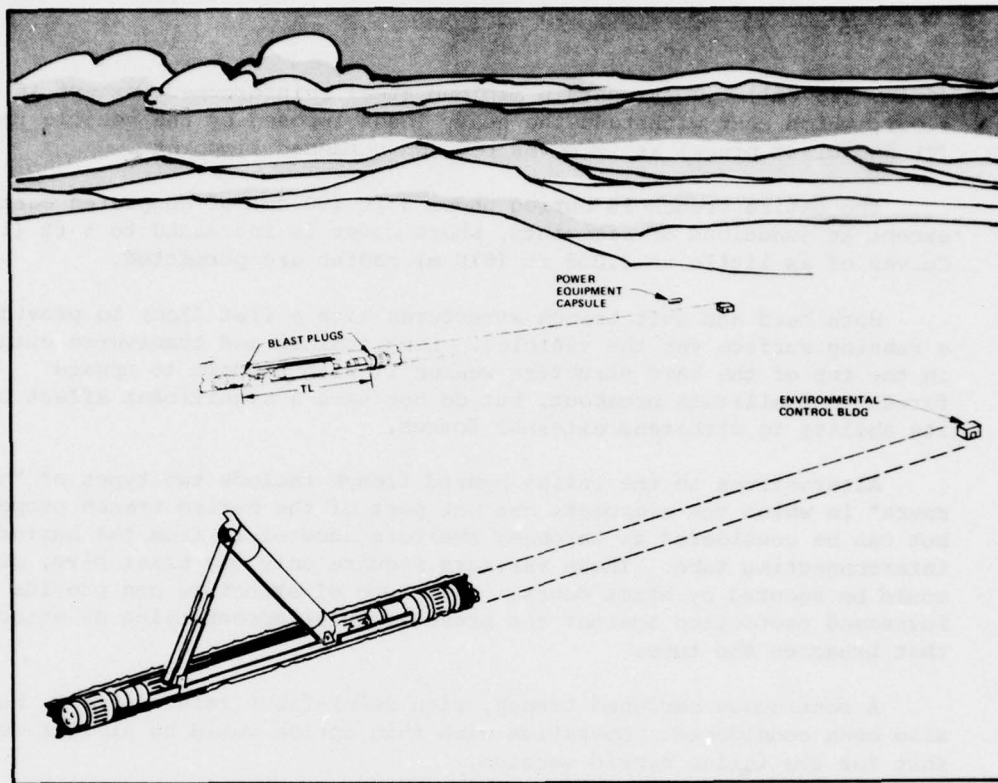


Figure 1-6. Two missiles in hybrid trenches with one prepared to launch as part of the Vandenberg AFB test operations should this option be chosen. Upon command to launch, the missile is raised, breaking through the protective cover, erected to an angle of not less than 50°, and launched from its protective canister.

movement of equipment and materials between the trenches and the primary support area, and also facilitates movement of the security patrols.

Alternative trench configurations include:

- the inline hybrid trench
- the spur trench
- the continuously hardened trench

In the inline hybrid trench structure as presently conceived, the hard aimpoints are reinforced concrete cylinders 13 ft (4 m) in inside diameter with 10 in. (25 cm) thick walls. The connecting soft structures are of lesser interior diameter (11.5 ft [3.5 m]) and wall thickness

(6 in. [15 cm])). They contain minimum steel reinforcement except in the floor, which must withstand the heavy loads imposed by the vehicle train (TL and blast plugs) as it moves between hardened aimpoints.

The entire trench is buried under 3 ft (90 cm) of compacted earth except at junctions of aimpoints, where cover is increased to 5 ft (1.7 m). Curves of as little as 2,000 ft (610 m) radius are permitted.

Both hard and soft trench structures have a flat floor to provide a running surface for the vehicles. Longitudinal and transverse cuts in the top of the hard structure weaken it with respect to upward forces to facilitate breakout, but do not have a significant affect on its ability to withstand external forces.

Alternatives to the inline hybrid trench include two types of "hybrid spurs" in which the aimpoints are not part of the buried trench proper, but can be considered as hardened shelters accessible from the buried interconnecting tube. These variants require only one blast plug, or could be secured by blast doors. This type of structure can provide increased protection against the pressure pulse accompanying an attack that breaches the tube.

A continuous hardened trench, with steel-fiber reinforcement, has also been considered. Operation with this option would be similar to that for the inline hybrid version.

MX Candidate Siting Areas at Vandenberg AFB (1.1.4)

Four candidate siting areas (CSAs) are currently under consideration as potential locations for the MX test facilities at Vandenberg (Figure 1-7). These four areas are in vicinities topographically identified as (listed from north to south):

- Shuman Canyon
- San Antonio Terrace
- Burton Mesa
- Lompoc Terrace

The location and terrain of each candidate siting area are briefly described in this section. To assess potential site-specific impacts of the project, prototype conceptual facility layouts have been produced for each candidate siting area for both trench and discrete launch point basing mode options. A conscious effort has been made to select siting arrangements that minimize adverse ecological and archaeological impacts while meeting the anticipated requirements of the project.

- Shuman Canyon Candidate Siting Area. The Shuman Canyon CSA, located at the foot of the southern flank of the Casmalia Hills,

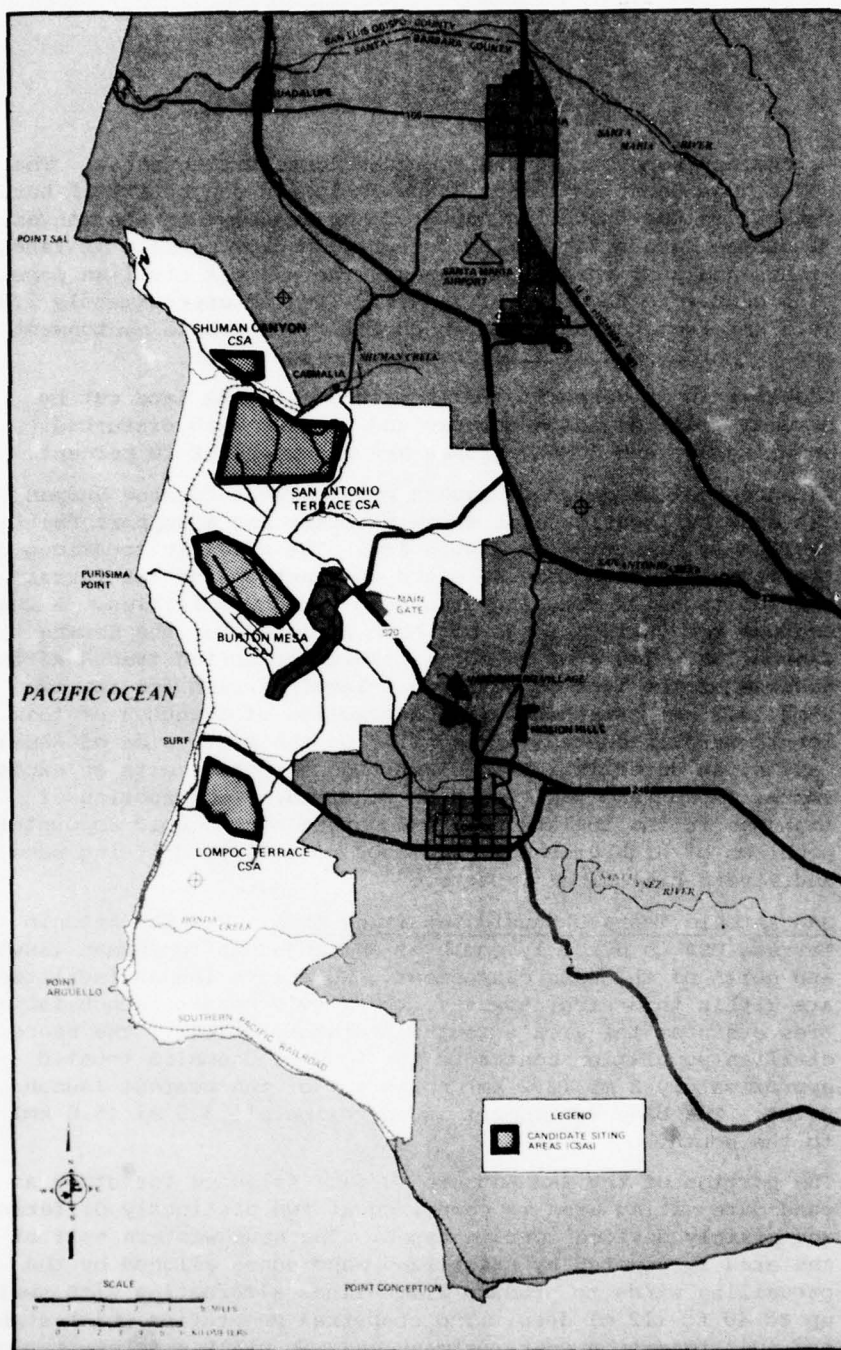


Figure 1-7. Locations of MX Candidate Siting Areas at Vandenberg AFB.

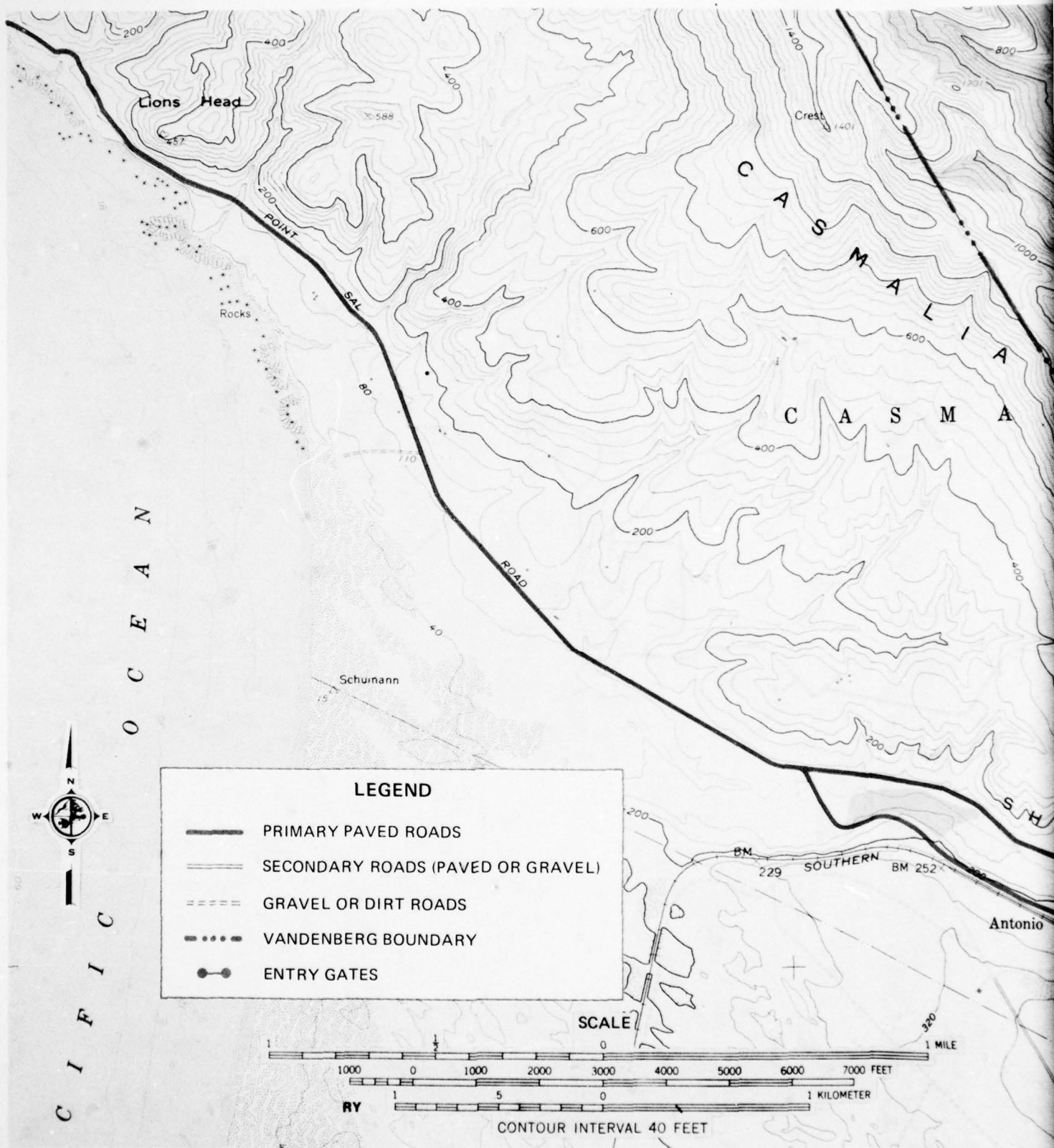
is the northernmost of the four candidate siting areas. The land under consideration is not actually in the canyon itself but, rather, in the foothills north of and adjacent to the canyon. Minuteman launch facilities currently occupy parcels of land both within and near this siting area. The nearest civilian population center is the town of Casmalia located approximately 2.8 mi (4.5 km) from the nearest launch point. The base cantonment is approximately 6.5 mi (10.5 km) to the southeast.

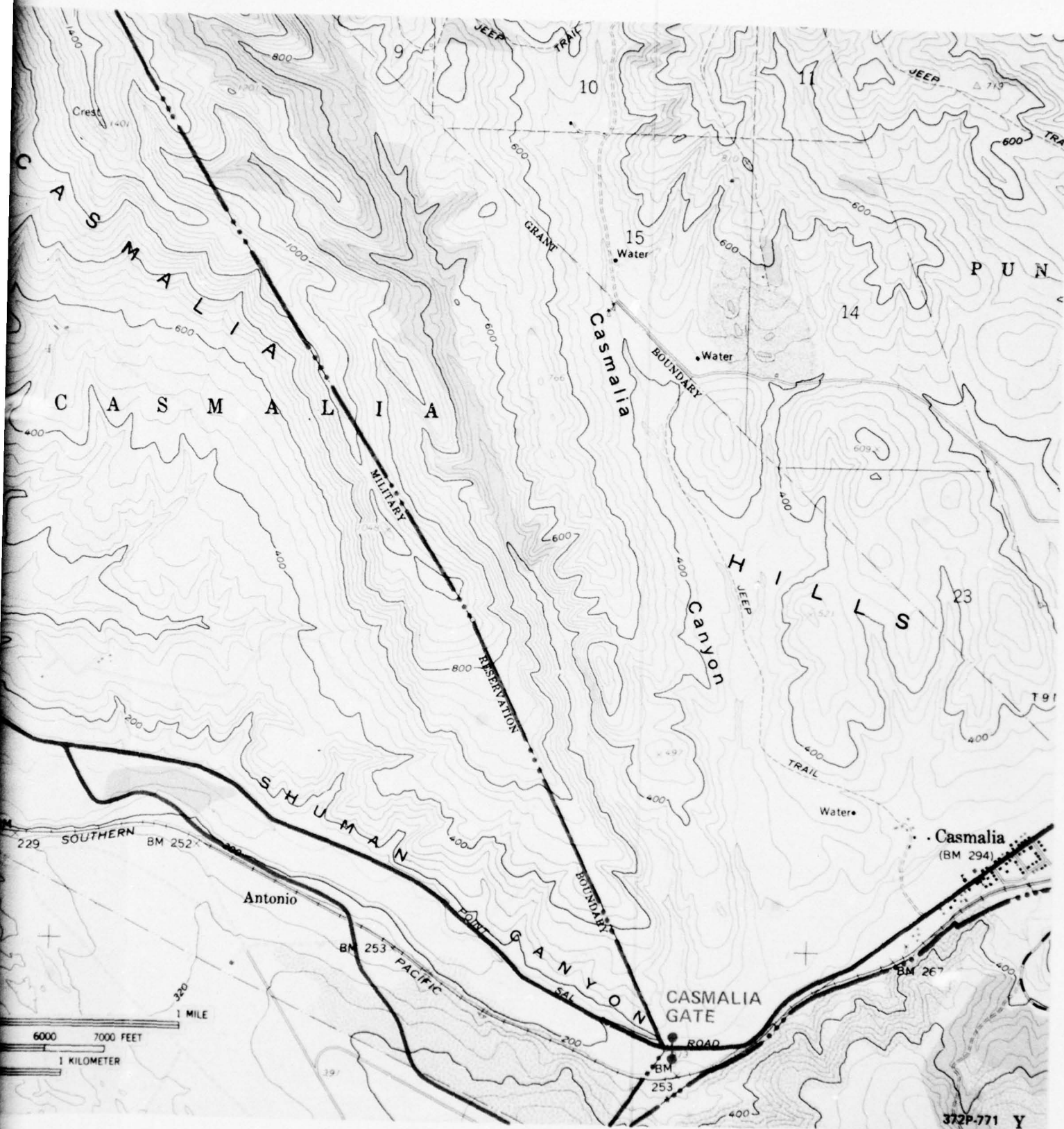
The terrain is generally well-drained, sloping land cut by several small drainage courses and covered with disturbed annual grassland. Many slopes are in excess of 10 percent.

A conceptual MX discrete launch point layout for the Shuman Canyon CSA showing locations for three shelters and a support facilities complex is presented in Figure 1-8. The specific locations of the three shelters were selected as functions of the terrain and the positions of existing Minuteman launch facilities. A conceptual trench layout has not been prepared for the Shuman Canyon CSA. The area is not suitable for buried trench siting because of the lack of sufficient level terrain for the two 2-mi (3.2 km) trenches. If construction of trenches of this length were attempted in the hills on the north side of Shuman Canyon, an unrealistically circuitous alignment with an excessive amount of cut and fill would be required. Construction of trenches in the lowland near the canyon mouth could encounter problems of high groundwater, flood potential, drifting sand, and severe biological impacts.

- San Antonio Terrace Candidate Siting Area. The San Antonio Terrace CSA is directly south of and adjacent to Shuman Canyon and north of the base cantonment. No active launch facilities are within this area, however, the Navy's Bomarc launch facilities are near the area's southwesternmost corner. The nearest civilian population center is the town of Casmalia located approximately 2 mi (3.2 km) northeast of the nearest launch point. The base cantonment is approximately 3.5 mi (5.6 km) to the south.

The portion of the San Antonio Terrace selected for study as a candidate siting area is comprised of two distinctly different and plainly divided terrain types. The southwestern half of the area is covered by stabilized sand dunes aligned by the prevailing winds to produce ridge-lines alternating with swales up to 40 ft (12 m) deep. The chaparral vegetation which stabilizes the dune formation contains many endemic plant species, including candidate endangered and threatened species. The northeastern half of the area is gently sloping even terrain covered with disturbed annual grassland and scattered shrubs. It is in this northeastern portion that the launch facilities are conceptually sited. This portion was selected primarily to avoid the rugged terrain and special interest vegetation of the stabilized dunes.





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Figure 1-8. Shuman Canyon Candidate Siting Area conceptual facility layout (discrete launch point basing mode).

Conceptual facility layouts for trench and discrete launch point basing mode options are presented in Figures 1-9 and 1-10. Only one of the basing modes will be selected for construction.

- Burton Mesa Candidate Siting Area. The Burton Mesa CSA, located just south of San Antonio Creek and directly north of and adjacent to the Vandenberg airfield, is the candidate siting area nearest to the base cantonment. Active launch facilities located nearby (at Purisima Point) are SLC-2 West and SLC-10 West which launch Thor rockets for orbital space missions. Southwest of Purisima Point is launch facility 395C which is used to test the Titan II rocket. Abandoned Atlas launch facilities are located at the north end of the candidate siting area. The nearest civilian population centers are Casmalia (5.5 mi [8.8 km] northeast), Vandenberg Village (7 mi [11.3 km] southeast), and the Federal Correctional Institution (7 mi [11.3 km] southeast). The closest part of the base cantonment is approximately 2 mi (3.2 km) southeast of the southern end of the trench alignment or 3.3 mi (5.3 km) southeast of the shelter locations.

The terrain is nearly flat with the exception of a deep ravine which cuts through the length of the area from northwest to southeast. The vegetation is mostly disturbed annual grassland



The Burton Mesa candidate siting area could possibly utilize portions of these abandoned Atlas facilities. The first targeted ICBMs in the free world were located on these launch pads.

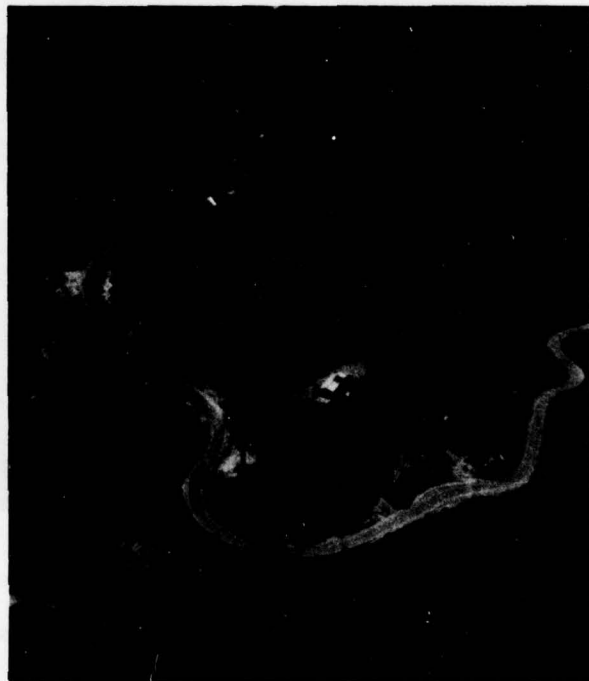
and scattered shrubs except for the southeastern portion which supports a large expanse of a relatively undisturbed unique chaparral community dominated by endemic plant species.

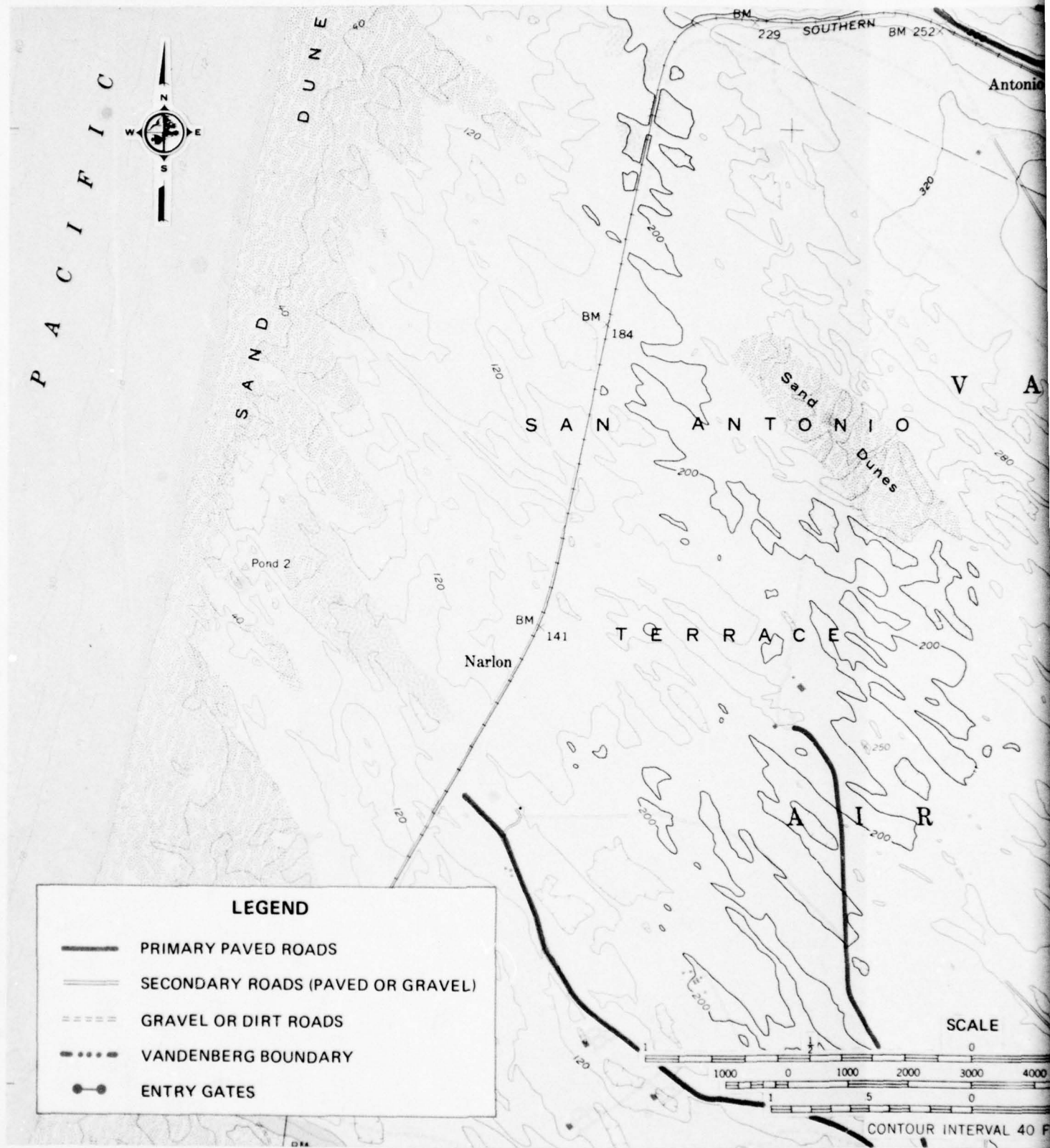
Conceptual facility layouts for trench and discrete launch point basing mode options are presented in Figures 1-11 and 1-12. Only one of the basing modes will be selected for construction.

- Lompoc Terrace Candidate Siting Area. The Lompoc Terrace CSA, located just south of the Santa Ynez River, is the southernmost of the candidate siting areas and the only one located on South Vandenberg. The nearest active launch facilities are SLC-3 East and SLC-3 West, located immediately south of the area, where Atlas rockets are launched for orbital space missions. Other launch facilities (SLC-4, SLC-5, and SLC-6) are located near the coast farther south (1.8 mi [2.9 km], 3.3 mi [5.3 km], and 4.1 mi [6.6 km], respectively). The nearest civilian population centers are the Federal Correctional Institution (4.3 mi [6.9 km] northeast) and the city of Lompoc (6 mi [9.7 km] east). The closest part of the base cantonment is 4 mi (6.4 km) to the northwest.

The terrain is gently rolling with some slopes in excess of 10 percent. The majority of the vegetation is disturbed annual grassland with occasional areas of coastal sage scrub.

Tranquillon Peak, highest mountain in the base or in the area, houses sophisticated tracking gear that has supported launch operations for twenty years.





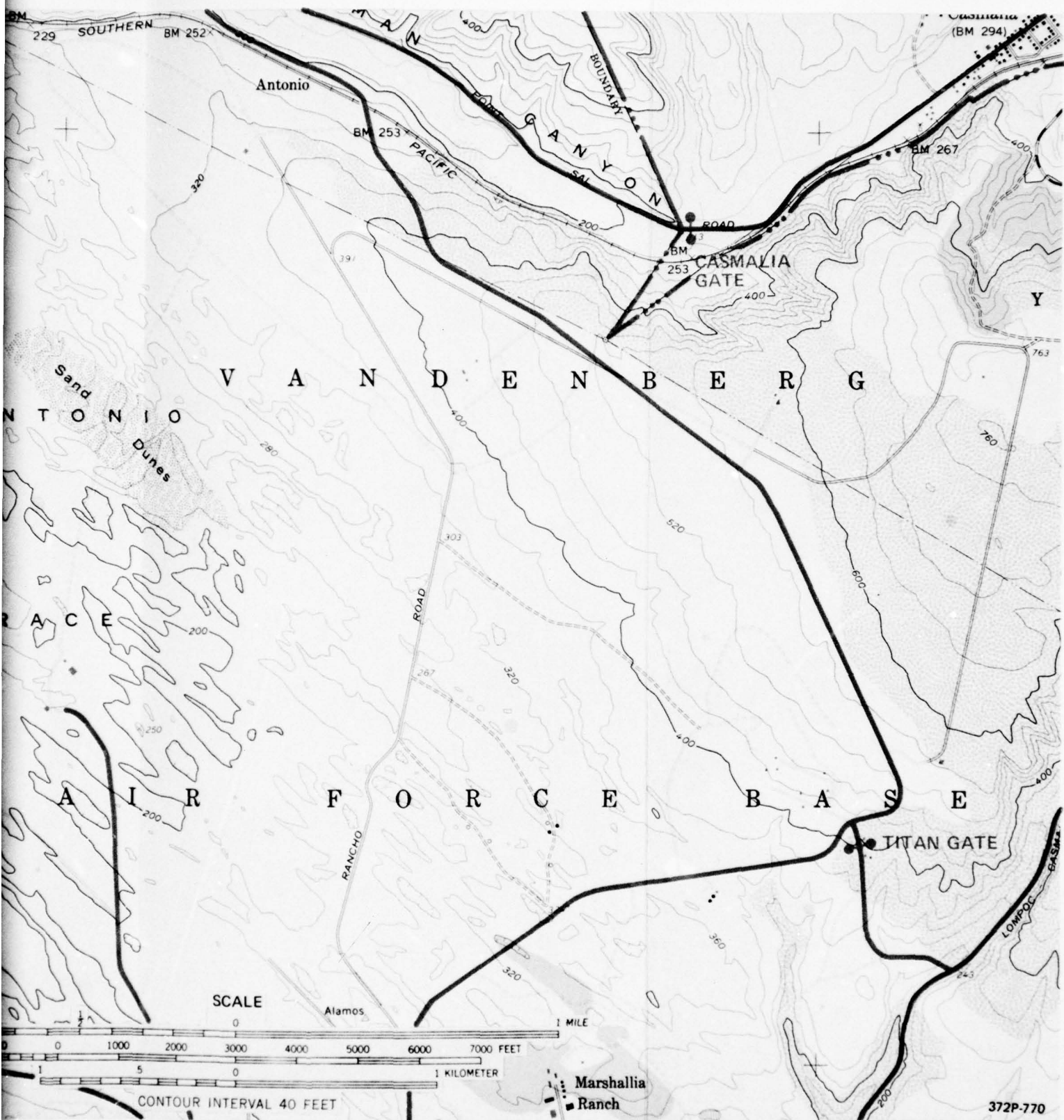
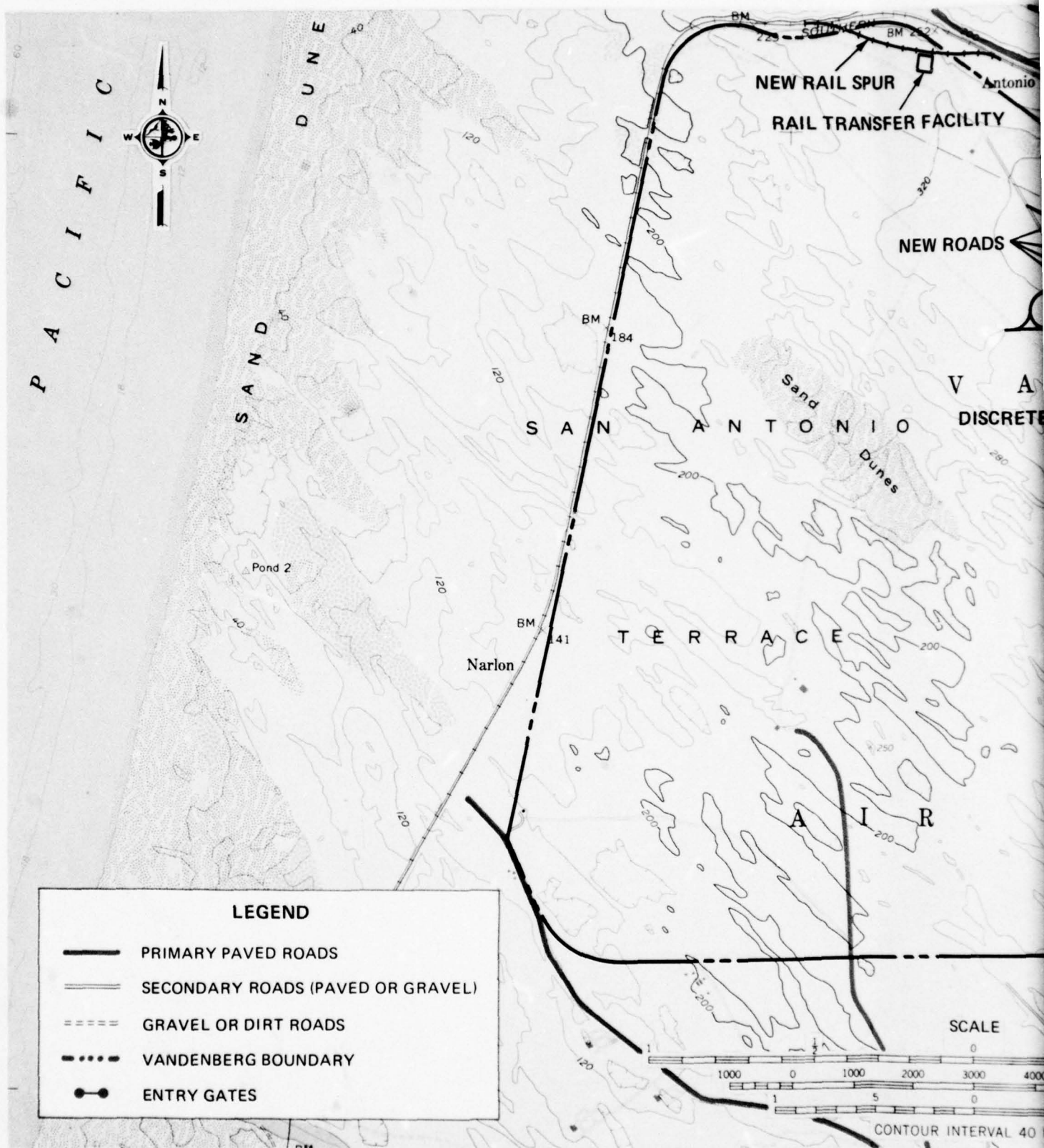


Figure 1-9. San Antonio Terrace Candidate Siting Area conceptual facility layout (trench basing mode).



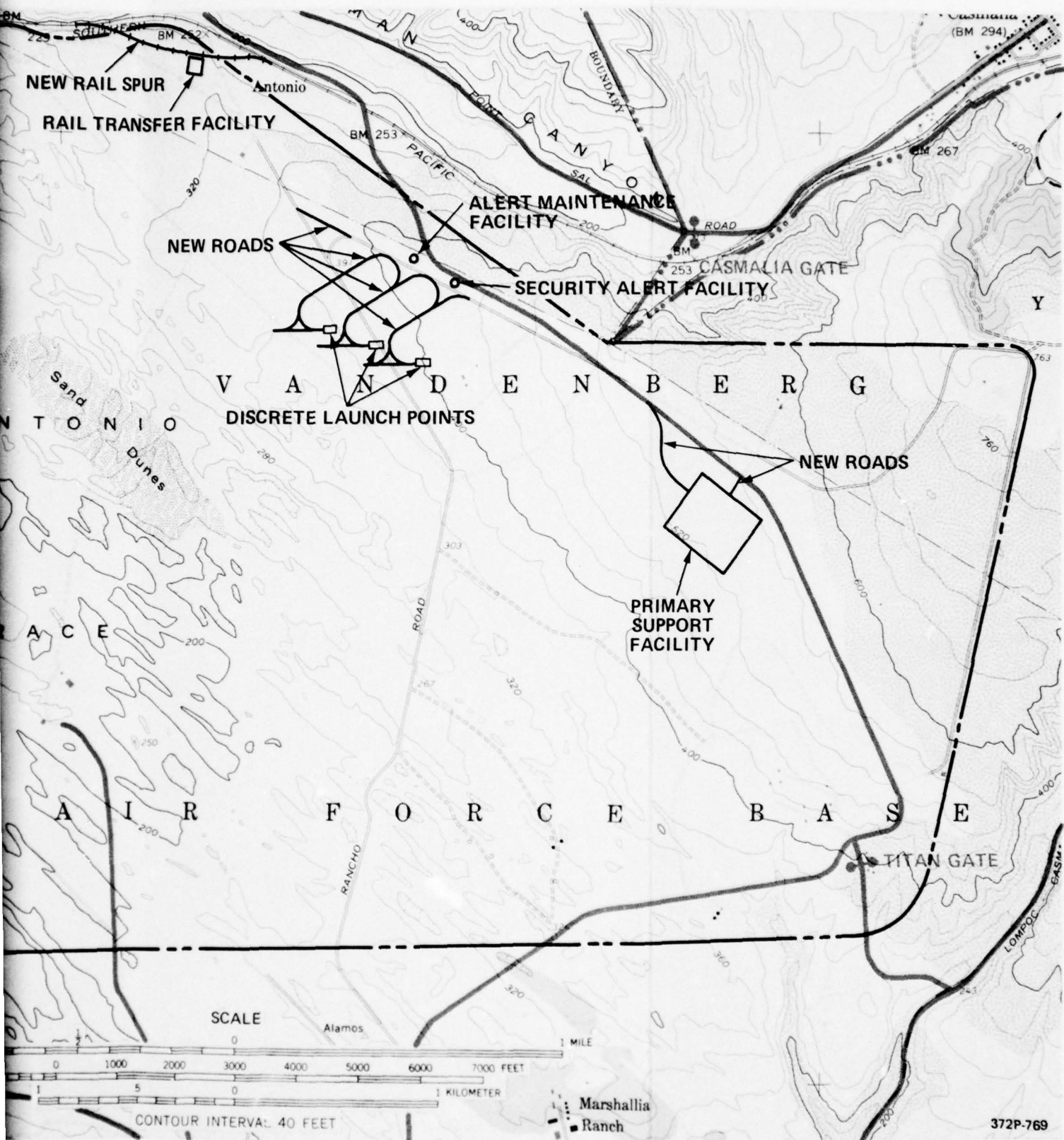
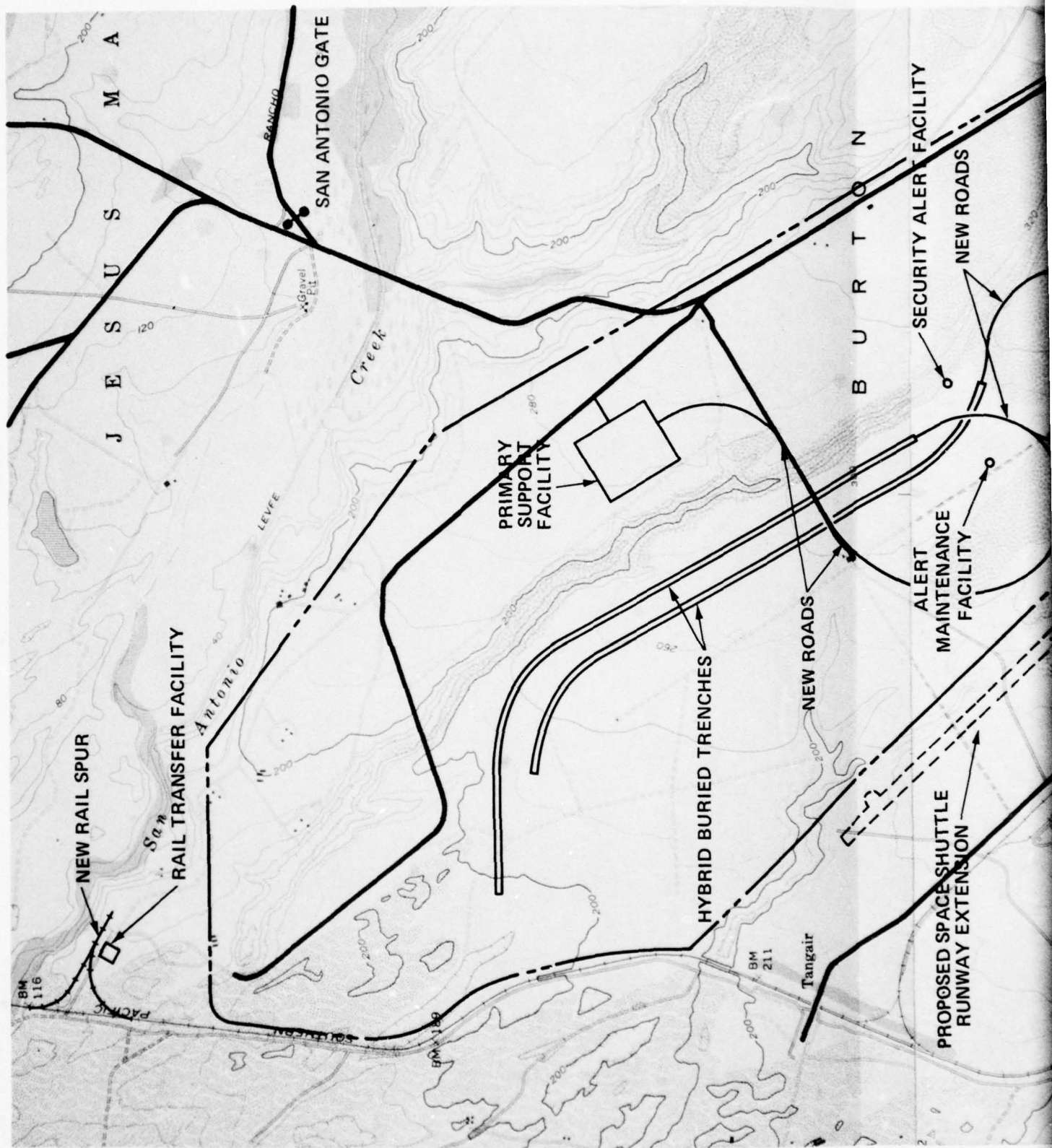
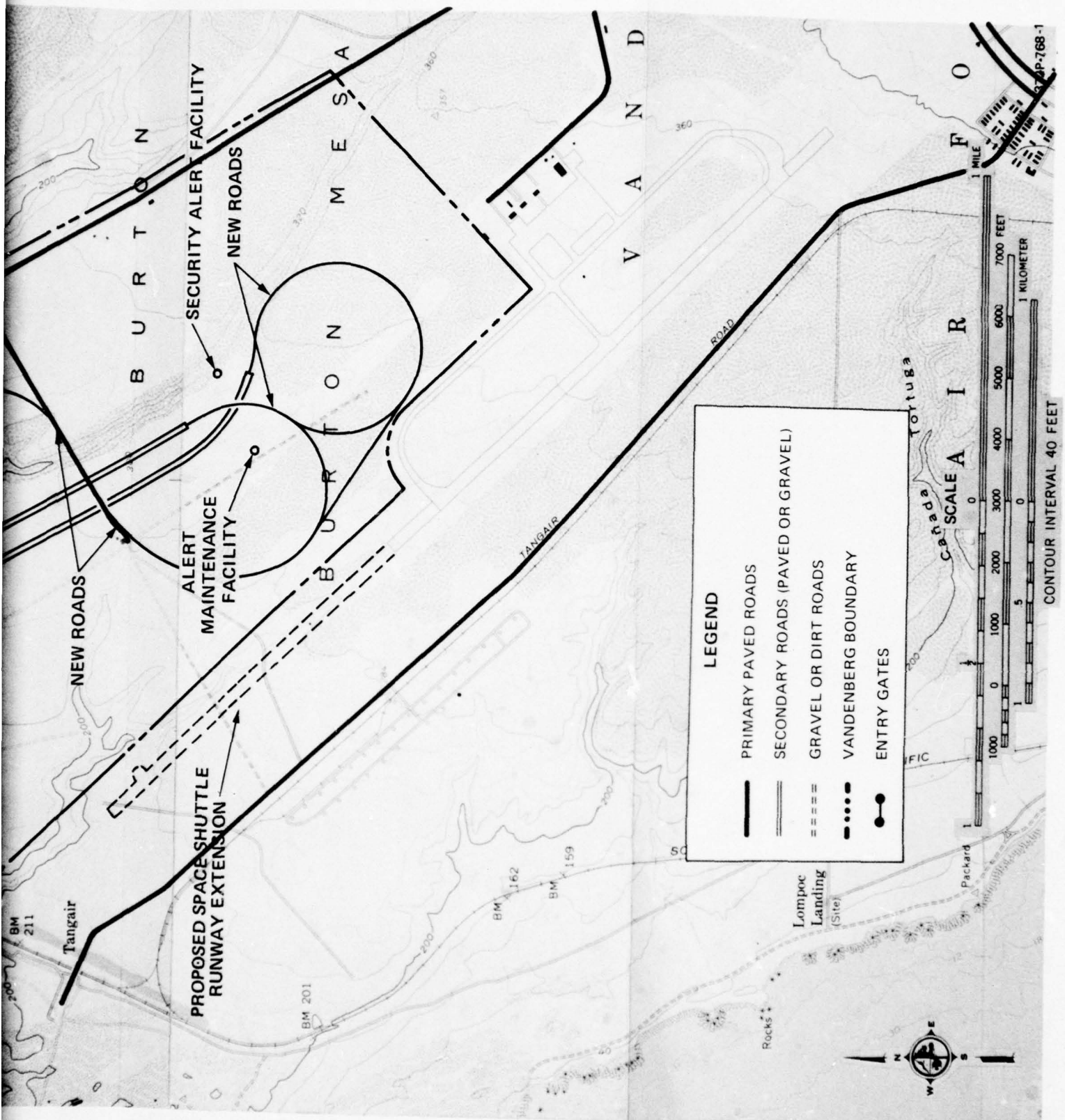


Figure 1-10. San Antonio Terrace Candidate Siting Area conceptual facility layout (discrete launch point basing mode).

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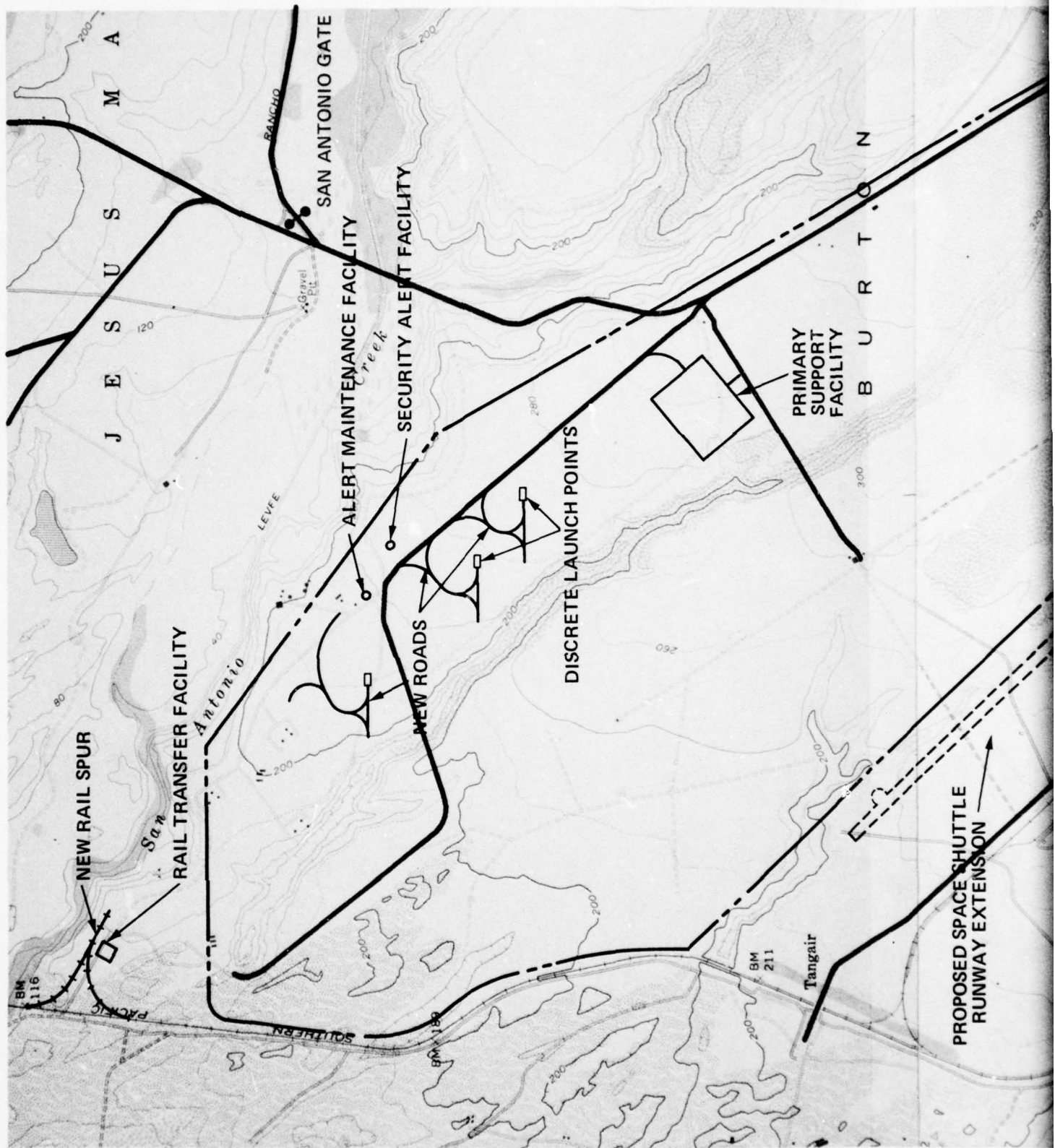


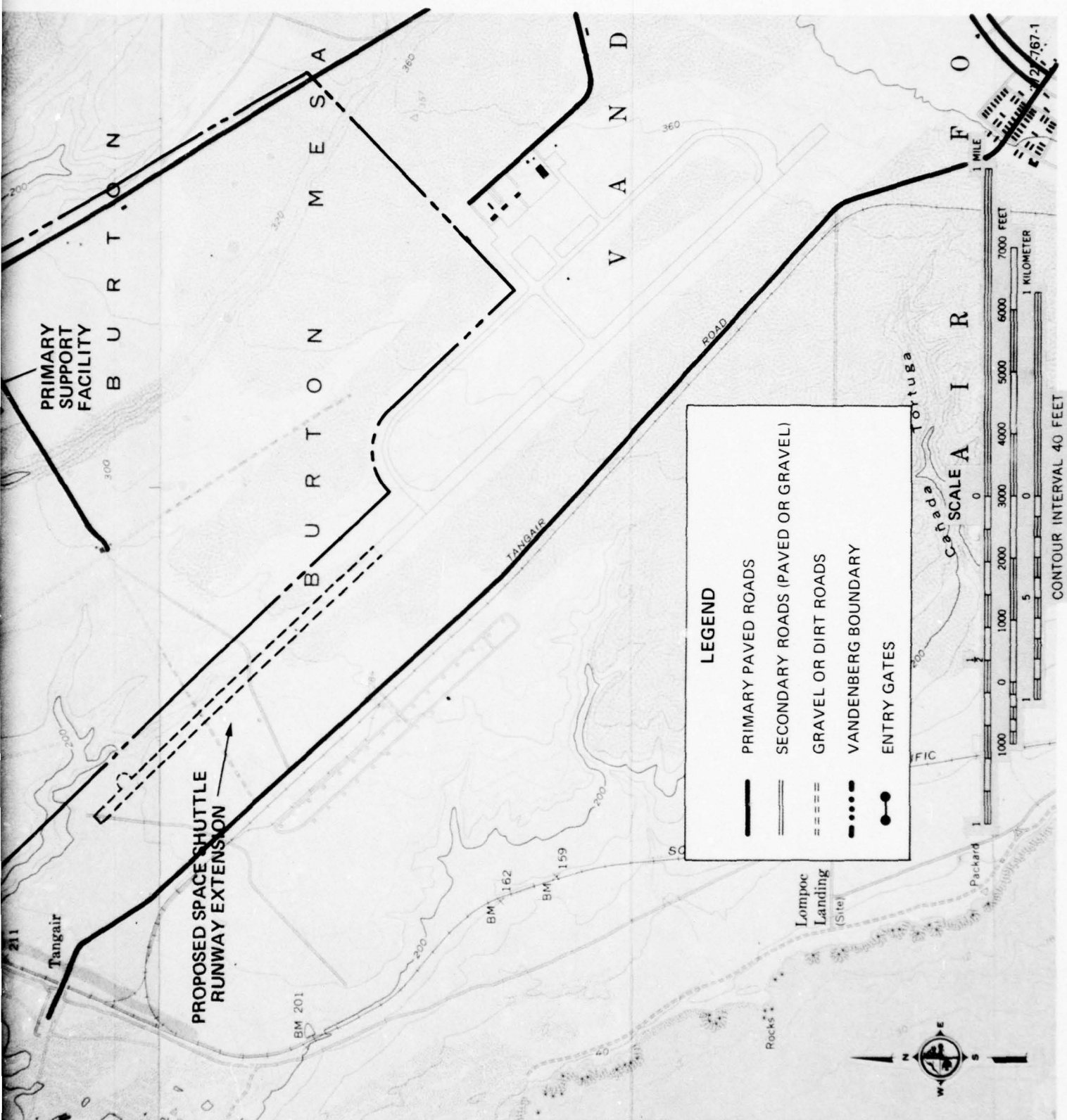


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Figure 1-11. Burton Mesa Candidate Siting Area conceptual facility layout (trench basing mode).

2

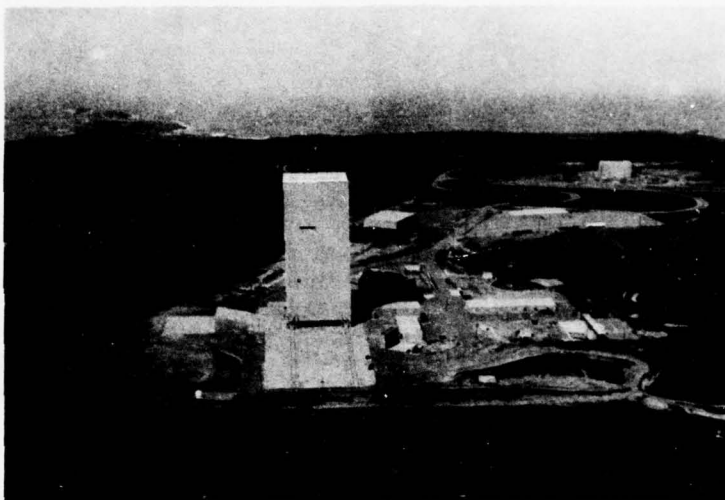




III-37

Figure 1-12. Burton Mesa Candidate Siting Area conceptual facility layout (discrete launch point basing mode).

2



Space Launch Complex-6 (SLC-6) on South Vandenberg will be modified for expanded use as part of the Space Shuttle Program

Conceptual facility layouts for trench and discrete launch point basing mode options are presented in Figures 1-13 and 1-14. Only one of the basing modes will be selected for construction.

Elements of Facility Construction Affecting the Environment (1.1.5)

The elements of the construction effort at Vandenberg that will affect the environment include the development of new facilities, modification of existing facilities, consumption of construction materials, and alteration of existing landscape at the selected site. The following discussions of these elements are based upon preliminary design concepts and conceptual facility layouts. Final facility design will provide a basis for a more detailed discussion.

Development of New Facilities (1.1.5.1). The type of impacts expected in the construction of the site support facilities complex is much the same as any multistructure complex. Paved area will be required around the buildings for heavy vehicular traffic. Increased pavement necessitates that facilities be provided for handling rain runoff. The particular conditions at the selected site could require that extensive site preparation precede the actual building of the complex, which will cover approximately 30 acres (12 ha).

In addition to the specific facility requirements, general site improvements will be required to support the test program. These improvements will include extension of existing roads and utilities into the

test area. Construction of access roads, as well as power, water, sewer, storm drain, gas, telephone, fire, and security alarm extensions, will be coordinated in accordance with existing Air Force standards.

For the trench option, the total land area disturbed in the construction of two 2-mi (3.2 km) trenches is estimated to be approximately 150 ac (61 ha). Construction of three shelters or pools would disturb a total of approximately 25 ac (10 ha). These figures represent actual construction site disturbance and do not give consideration to additional areas at other locations that might be required for service access, storage, and other uses related to construction.

The basing mode selected will be a primary factor governing the magnitude of the onsite effects realized in the construction phase of the test program at Vandenberg. Table 1-2 summarizes the amount of land disturbed in the construction of the MX launch and support facilities for each basing mode. Construction associated with the buried trench option would involve a total disturbance of over three times as much land area as for the shelter option.

Table 1-2. Land areas disturbed during construction of MX launch and support facilities.

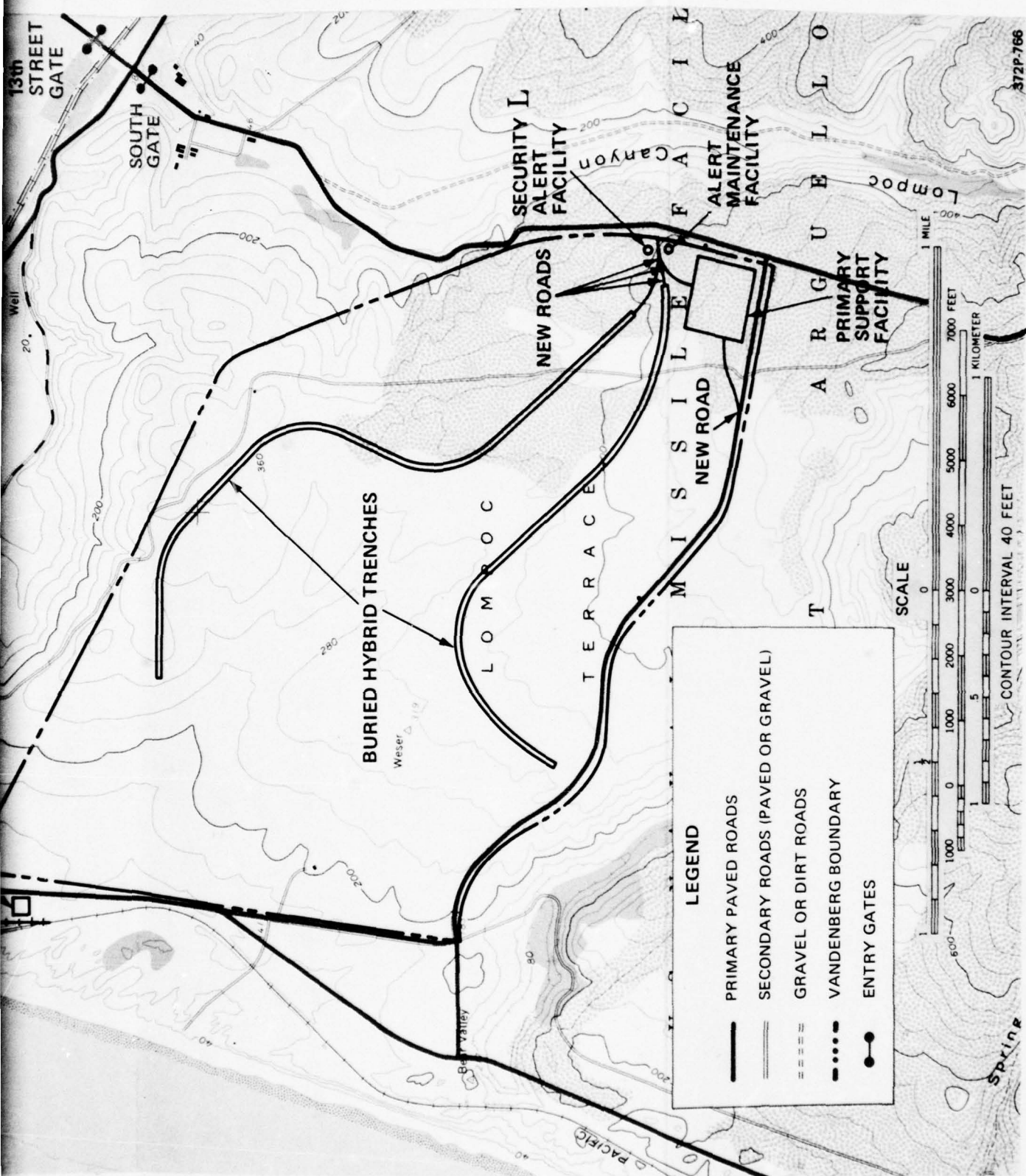
BASING OPTION	LAUNCH FACILITIES	SUPPORT FACILITIES	TOTAL
Trench	150 acres (61 hectares)	30 acres (12 hectares)	180 acres (73 hectares)
Shelter or Pool	25 acres (10 hectares)	30 acres (12 hectares)	55 acres (22 hectares)

Construction Material Estimates (1.1.5.2). Tables 1-3 through 1-5 present estimates on the material required for the construction of the proposed test facilities. Final facility design will provide a basis for a more precise estimate of these requirements. The construction material estimates for the site support facilities in Table 1-3 are based on the square foot requirements of the facilities and previous construction experience at Vandenberg. The data in Tables 1-4 and 1-5 indicate that construction of 4 mi (6 km) of inline hybrid trench would require about 18 times as much cement, sand, aggregate, fly ash, and steel and about 5 times as much water as would be required to construct three horizontal loading dock shelters.

Cost and Manpower Estimates (1.1.6)

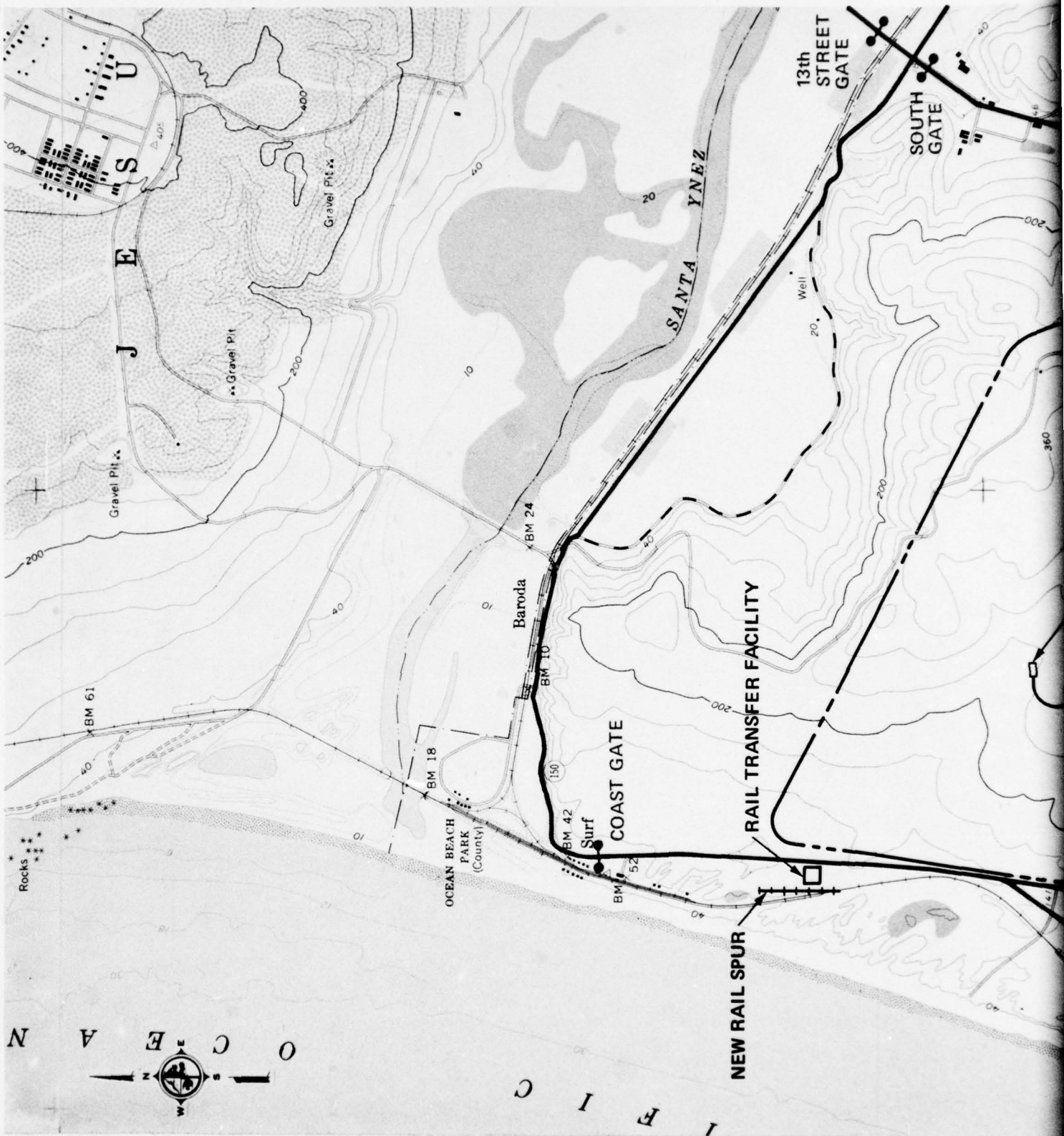
This section addresses the estimates of the cost and manpower for the construction of the test facilities and the operation of the test program.

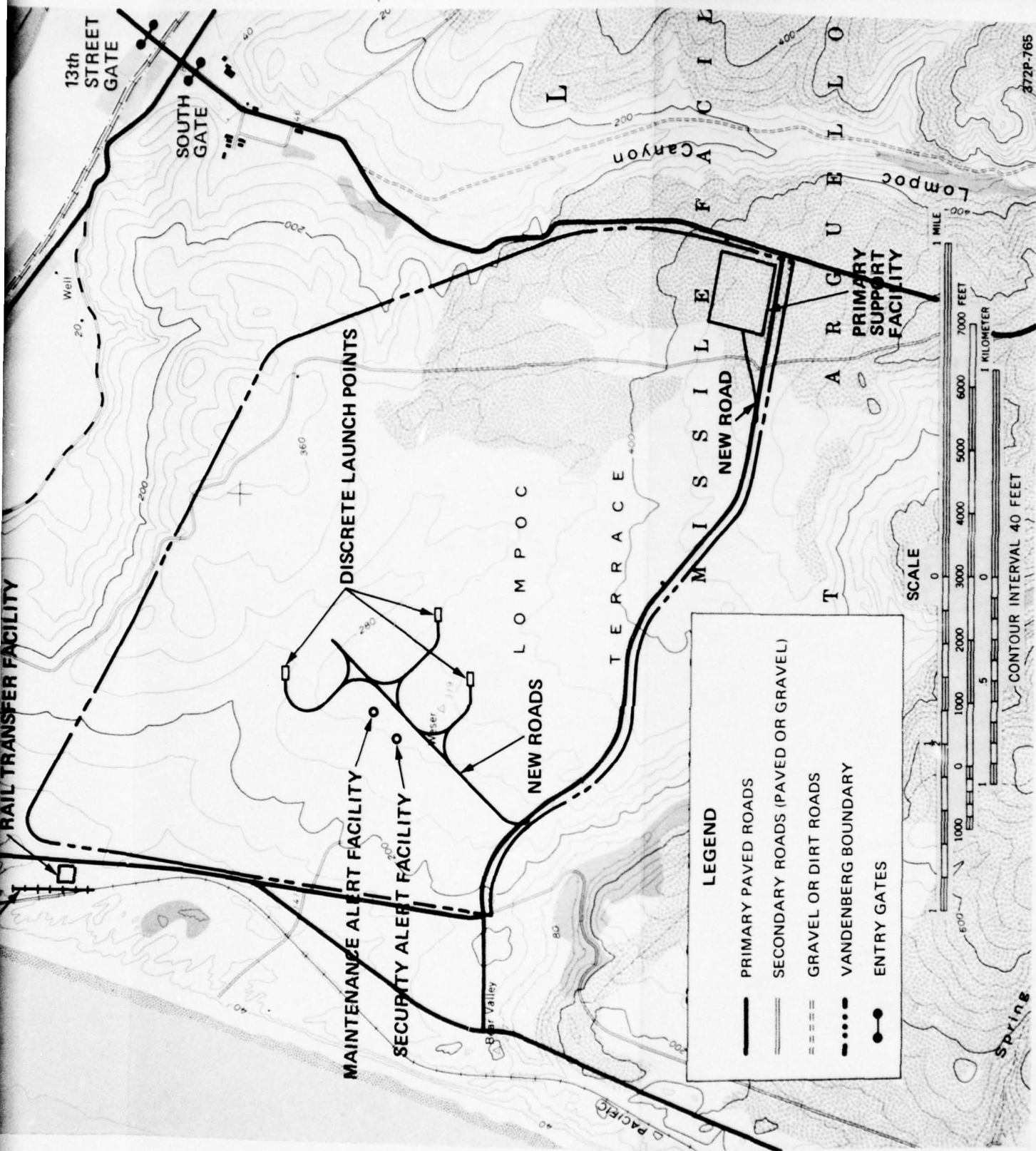




III-41

Figure 1-13. Lompoc Terrace Candidate Siting Area conceptual facility layout (trench basing mode).





III-43

Figure 1-14. Lompoc Terrace Candidate Siting Area conceptual facility layout (discrete launch point basing mode).

2

Table 1-3. Construction material estimates for site support facilities.

MATERIAL	REQUIREMENTS
Cement	2,850 tons (2,585 tonnes)
Aggregate	6,500 tons (5,895 tonnes)
Reinforcing Steel	1,430 tons (1,297 tonnes)
Structural Steel	675 tons (612 tonnes)
Water	265,000 gal (1,004 m ³)

372T-3003

Table 1-4. Construction material estimates for trench construction.

MATERIAL	REQUIREMENTS PER STATUTE MILE	REQUIREMENTS FOR 4 MILES (6.4 KM) OF TRENCH
Cement	1,686 tons (1,529 tonnes)	6,745 tons (6,118 tonnes)
Sand	2,907 tons (2,637 tonnes)	11,626 tons (10,545 tonnes)
Coarse Aggregate	4,446 tons (4,033 tonnes)	17,784 tons (16,130 tonnes)
Fly Ash	228 tons (207 tonnes)	912 tons (827 tonnes)
Steel	167 tons (151 tonnes)	668 tons (606 tonnes)
Water	2,375,000 gal (8,996 m ³)	9,500,000 gal (35,985 m ³)

372T-3004

Table 1-5. Construction material estimates for shelter/pool construction.

MATERIAL	REQUIREMENTS PER STRUCTURE	REQUIREMENTS FOR THREE STRUCTURES
Cement	119 tons (108 tonnes)	357 tons (324 tonnes)
Sand	230 tons (209 tonnes)	691 tons (627 tonnes)
Coarse Aggregate	353 tons (320 tonnes)	1,058 tons (960 tonnes)
Fly Ash	16 tons (14.5 tonnes)	48 tons (43.5 tonnes)
Steel	12 tons (11 tonnes)	35 tons (32 tonnes)
Water	612,667 gal (2,321 m ³)	1,838,000 gal (6,962 m ³)

372T-3005

The overall personnel and schedule for MX testing and associated construction at Vandenberg is summarized in Figure 1-15. The derivation of these values and associated cost estimates are presented in the following sections.

Construction Cost Estimates (1.1.6.1). There are nine significant facility requirements for the MX weapon system test program at Vandenberg. They are as follows:

1. Rail transfer facility
2. Mechanical maintenance facility
3. Integrated test facility
4. Payload assembly building
5. Stage modification facilities (3)
6. Stage storage pads (3)
7. Stage IV processing facility
8. Missile assembly building
9. Basing mode facilities (trench or shelter)

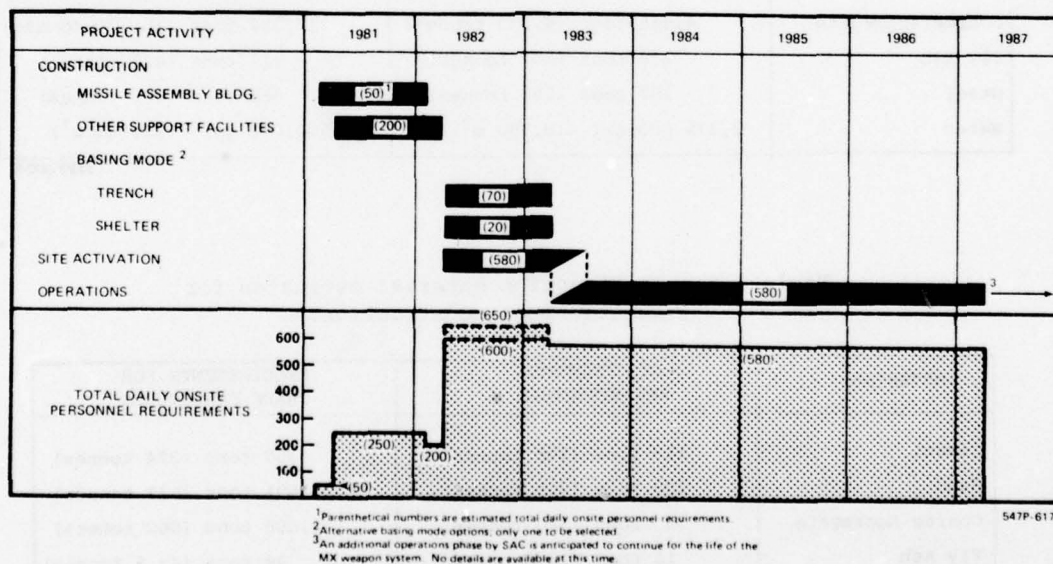


Figure 1-15. MX construction, activation, operations, personnel requirements and tentative schedule for Vandenberg AFB.

Detailed cost estimates for each facility are not yet available, but dollar estimates of \$50 million (1977 dollars) have been proposed for the construction of the required facilities. Every effort is being made to use existing facilities to reduce overall costs.

Construction is estimated to span 2 years. The construction schedule for the first seven items is assumed to be April 1981 to April 1982. Construction of basing mode facilities is assumed to begin in April 1982 and terminate in April 1983. The schedule for the missile assembly building construction has been set at February 1981 to February 1982. In all cases, construction will be followed by the installation of support equipment and site activation in accord with the MX weapon system test program schedule. The schedule is dependent on program direction and funding.

Manpower estimates have been developed for the first seven items on the facility list and are displayed in Table 1-6. The table covers the craftsmen and their foremen, plus military and civilian supervision, inspection, and overhead (SIOH) personnel who will be required during construction. SIOH personnel are estimated to include five military and five contractor representatives. Since these facilities are to be constructed over an estimated period of 12 months, labor requirements are 200 man-years including 140 man-years of craft labor. Using 1977 craft labor rates per man-year, including benefits in Santa Barbara, the craft labor cost would be about \$6,536,000. The overall construction cost estimate is \$23,343,000 (1977 dollars) for the first seven items on the facility list.

The missile assembly building (item eight on the list) is estimated at \$5,440,000 in 1977 dollars. Using the 28 percent factor for craft labor cost, craftsmen at Santa Barbara rates (1977) would cost \$1,532,200. At an average \$34,400 per man-year, this covers 45 man-years distributed over the assumed time span of February 1981 to February 1982 (a monthly average of 45 craftsmen on the job). Several additional SIOH personnel would be required; perhaps 4 per month over the 12 month construction period, resulting in a total monthly average of 49 personnel.

If the trench is the preferred basing mode, the scale of construction at Vandenberg would be approximately \$12,700,000. Santa Barbara craft rates convert to labor costs of \$2,210,000 with the remaining \$10,500,000 being materials costs. Manpower requirements are shown in Table 1-7 and involve an average onsite workforce of 71 people (852 man-months/12 months).

If shelters or pools are the preferred basing mode, the scope of the construction project at Vandenberg would be substantially reduced. For example, three shelters would involve a total cost of \$1,385,000 including labor costs of \$600,000. About 230 man-months of effort would be necessary for average onsite labor of just over 19 people as shown in Table 1-8.

Table 1-6. Manpower requirements for support facilities construction.

LABOR CATEGORY	LABOR REQUIREMENTS (MAN-MONTHS/YEAR)
Asphalt Finishers	24
Carpenters	156
Cement Finishers	144
Communications Workers	60
Crane Operators	12
Electricians	216
Equipment Maintenance	60
Foremen	288
Graders	24
Laborers	552
Plumbers	276
Steel Workers	132
Surveyors	36
Truck Drivers	300
Total Craftsmen	2,280
SIOH Personnel	120
Total Manpower	2,400

372T-3006

Source: SAMSO, 1977.

A 1-year site activation period is included within the construction phase from April 1982 to April 1983. The labor force involved is estimated at an average of 580 personnel over the year. Total cost associated with this activity and these personnel is estimated at \$45,000 per man-year, with \$20,000 as the average salary. Total cost would thus be \$26,100,000 (to cover salary, benefits, burden, fee, and consumables) of which about \$19,600,000 would be expended in 1982 and \$6,500,000 in 1983.

Operations Cost Estimates (1.1.6.2). Available cost and manpower estimates for the operation of the MX test program at Vandenberg are tentatively estimated as:

- \$90 million for integrated testing and support systems

Table 1-7. Manpower requirements for trench construction.

LABOR CATEGORY	LABOR REQUIREMENTS (MAN-MONTHS/YEAR)
Carpenters	29
Cement Masons	14
Electricians	35
Iron Workers	15
Laborers	201
Operating Engineers	288
Truck Drivers	43
Total Craftsmen	625
SIOH Personnel	227
Total Manpower	852

Source: Parsons, 1977.

372T-3007

- \$60 million for test equipment covering both special test equipment (STE) used up during testing and reusable test support equipment (TSE)
- \$200 million for conducting MX flight tests

Operational cost and manpower requirements will have potential socioeconomic impacts in Santa Barbara County, especially in the North County, which will be most heavily involved. It is estimated that 525 to 650 personnel will be added directly to the Vandenberg work force for the test program (25 to 50 Air Force personnel and 500 to 600 contractor personnel). An average of 30 Air Force and 550 contractor personnel is used in this report and this coincides with site activation labor requirements. The site activation personnel are assumed to remain for operations and maintenance tasks required to initiate and complete the MX weapon system test program.

An average cost of \$45,000 per man-year (1977 dollars) is used for contractor personnel. This figure includes benefits, burden, and fee together with an allowance for consumables and services incidental to activation and tests. The overall costs, assuming 580 persons at an average cost of \$45,000 per year for four years would be \$104,400,000 (1977 dollars).

Table 1-8. Manpower requirements for shelter construction (three shelters).

LABOR CATEGORY	LABOR REQUIREMENTS (MAN-MONTHS/YEAR)
Crane Operators	8
Electricians	1
Finishers	5
Foremen	16
Hosemen	4
Iron Workers	3
Laborers	39
Mechanics	10
Millwrights	16
Oilers	4
Operators	33
Powdermen	1
Safety Men	4
Truck Drivers	26
Welders	5
Total Craftsmen	175
SIOH Personnel	55
Total Manpower	230

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Source: Parsons, 1977.

Testing and activation of the basing mode facilities (operations) are expected to run from April 1983 to March 1987. Many personnel would also remain for the balance of the life cycle of the MX weapon system to support SAC's operational testing.

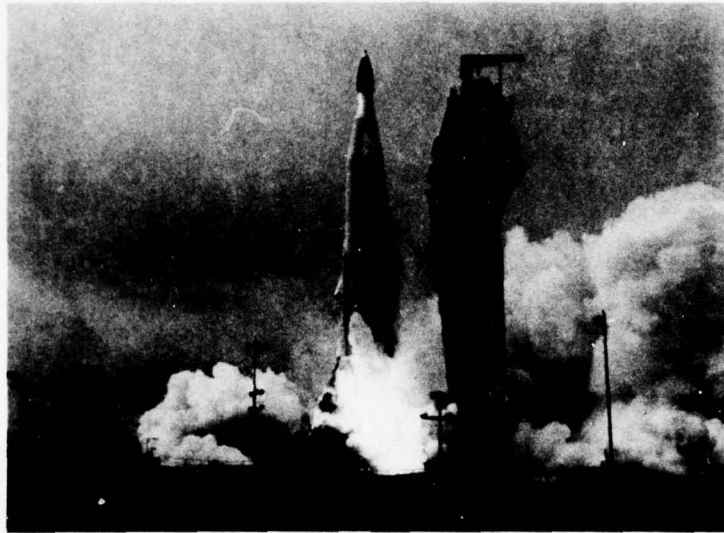
1.2 DESCRIPTION OF THE EXISTING ENVIRONMENT

Historical Setting (1.2.1)

The first recorded inhabitants of the Vandenberg area were Chumash Indians living in villages near or on the coast. There were approximately 15,000 Chumash in Santa Barbara County when Father Junipero Serra and his successors founded the missions of La Purisima, Santa Ines, and Santa Barbara. Cattle, valued for hides and tallow, and other agricultural products, soon made the Santa Barbara County missions thriving trade centers. In 1834, the missions were removed from control by the church and the mission holdings were divided into 30 large ranches. For about 20 years, the production of sheep and cattle was the most important industry of the area. As a result of a drought in the 1860s, cattle raising declined rapidly and most of the large ranches were subdivided, marking a transition from ranching to farming. Both Lompoc (ca. 1875) and Santa Maria (1905) developed as agricultural trading centers during this period. Agricultural development was further stimulated by the completion of the railroad from Los Angeles to Santa Barbara in 1887 and its extension to San Francisco in 1901. Farming continued to grow in the 1890s, when artesian wells were developed, thus allowing extensive irrigation. Agriculture continued to be the dominant industry until the establishment of Camp Cooke Army Base in 1942.

In September 1957, Camp Cooke was assigned to the Air Force as an ICBM/IRBM operational training base. The southern portion of the base was redesignated Naval Missile Facility, Point Arguello, California, and assigned to the Navy. Camp Cooke Air Force Base was renamed Vandenberg Air Force Base in October 1958, honoring General Hoyt S. Vandenberg, the second Air Force Chief of Staff. In 1964, the Defense Reorganization Act resulted in the transfer of the Naval Missile Facility at Point Arguello to the Air Force. This addition, plus the purchase of the Sudden and Scolari properties in 1966, increased the total base area to 98,400 acres (39,360 ha), making it the third largest air base in the U.S.

Since 1958, Vandenberg has operated with the dual mission of a missile test base and an aerospace center. Its transformation into a modern missile/space launch complex involved the expenditure of more than \$1.5 billion within a decade. It now contains a wide assortment of launch facilities that are capable of accommodating practically every type of launch vehicle



The Lompoc-Santa Maria communities have become accustomed to SAC test launches from Vandenberg. The largest early "birds" were Atlas launches pictured here on Burton Mesa.

in the aerospace inventory. It is headquarters for the First Strategic Aerospace Division (1 STRAD), the host command for the Strategic Air Command (SAC), and the Space and Missile Test Center (SAMTEC), which operates the Western Test Range for the Air Force Systems Command.

During the past 25 years, much of northern Santa Barbara County's change from an agricultural to a diversified industrial economy was the result of establishing Camp Cooke, later Vandenberg Air Force Base, in 1942. The military buildup necessitated a large influx of base personnel and their families, as well as induced growth in aerospace-oriented industries throughout the county.

History of Santa Barbara County (1.2.1.1) Santa Barbara County is currently the sixteenth most populous county in California, accounting for 1.3 percent of the total state population. In October 1975, the California Department of Finance conducted a countywide special census for Santa Barbara County. The special census, enumerated 280,605 people in the county, an increase of 14,905 over 1970 population levels. The annual growth of 1.2 percent in the period 1970 to 1975 was a much slower growth rate than in the prior decade, when the development of Vandenberg, expansion of the University of California at Santa Barbara, and the growth of research and development and manufacturing firms spurred a population increase of 4.6 percent annually. Growth during the 1950s averaged an even more rapid 5.6 percent annually. Table 1-9 traces countywide growth from 1960 to 1975.

Table 1-9. Population growth in Santa Barbara County, 1960, 1970, and 1975.

EFFECTS AREA	HISTORIC POPULATION			AVERAGE ANNUAL GROWTH RATE (PERCENT)		AREA POPULATION AS A PERCENT OF 1975 COUNTY TOTAL
	1960	1970	1975	1960-70	1970-75	
North Coast Area	75,707	113,899	114,295	4.2	0.1	40.7
Santa Ynez Valley	6,462	8,328	11,250	2.6	6.2	4.0
Central Valley	1,344	1,212	1,140	-0.1	-1.0	0.4
Lompoc Valley	28,234	47,729	43,887	5.4	-2.6	15.6
Lompoc City	14,420	25,284	24,237	5.8	-0.9	8.6
Vandenberg Vlg.	—	—	5,770	—	—	2.1
Mission Hills	—	—	2,632	—	—	0.9
Vandenberg AFB	11,040	16,566	13,616	4.1	-3.9	4.8
Santa Maria Valley	39,667	56,630	58,018	3.6	0.5	20.7
Santa Maria City	20,030	32,749	33,645	5.0	0.5	12.0
Guadalupe	4,190	3,858	3,808	-0.9	-0.3	1.4
Orcutt	11,539	19,477	20,335	5.4	0.9	7.3
Casmalia	—	—	200	—	—	0.1
South Coast Area	93,255	150,425	166,310	4.9	2.0	59.3
Santa Barbara	58,760	70,215	72,238	1.8	0.6	25.7
Goleta Valley	20,060	60,184	69,664	11.6	3.0	24.8
Carpinteria	—	9,959	13,084	—	5.6	4.7
Montecito	—	7,747	8,954	—	2.9	3.2
Santa Barbara County	168,962	264,324	280,605	4.6	1.2	100

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For the purposes of this report, Santa Barbara County has been divided into two major regions locally termed the North County and the South Coast. In the South Coast, the introduction of many electronics and research and development firms in the Santa Barbara-Goleta area provided a large stimulus to the area's economic base. Population increased most rapidly in the 1960-1970 period, growing at the annual rate of 6.1 percent, such that the South Coast's 1970 population equalled 150,430 persons. Of the total county population, the South Coast's share increased from 55.1 percent in 1960 to 56.9 percent by 1970.

The Goleta Valley sustained the largest increase, tripling its 1960 population to 60,810 persons by 1970. Over the same 10-year period, the city of Santa Barbara grew from 58,760 to 70,220 persons. Thus, by 1970, Santa Barbara was being strongly challenged by Goleta, which had doubled its share of total South Coast population. Much of Goleta's 1960-1970 extremely rapid growth rate, 11.6 percent per year, resulted from space exploration-related industries and rapid growth of the University of California at Santa Barbara (UCSB). It is not possible to distinguish between the separate cause and effect relationships which resulted. Santa Barbara's annual rate of growth over 5 years (1970-1975) declined to only

0.6 percent, yielding a 1975 population of 72,240 persons. Goleta Valley's rate of population increase also slowed; its 1970-1975 annual rate of growth equalled 3.0 percent, yielding 69,660 persons by 1975.

History of Vandenberg's Environs (1.2.1.2). Vandenberg and its environs encompasses those communities most affected by Vandenberg activities, namely the base itself, Lompoc, Vandenberg Village, Mission Hills, the Santa Maria and Orcutt-Y areas, Guadalupe and the Santa Ynez Valley. Its share of total county population has declined, so that it now comprises less than one-half (40.7 percent) of the 1975 total. In the following discussion, most detail is provided for Vandenberg, and those areas immediately adjacent, the Lompoc and Santa Maria valleys, which together have been the location of 92 percent of all Vandenberg working population living offbase.

Historic population trends of the Lompoc and Santa Maria valleys can be attributed to three major factors:

- Geographic isolation
- Economic prosperity
- Activity at Vandenberg during the last two decades

Isolation from the rapidly developing southern California region left the area relatively stable prior to the establishment of Camp Cooke during World War II. The physical barriers (both water and mountains), which surround the northern part of the Santa Barbara County, insulated it sufficiently so that growth was based almost exclusively on the local economy; agriculture, oil production, and mining.

Santa Barbara's quiet pace of life and pleasant environment have made the city a desirable retirement community. Nearly 12 percent of the population of the South Coast is 65 years or older.



With the advent of World War II and the establishment of Camp Cooke as an army base, the first heavy in-migration occurred. The populations of Lompoc and Santa Maria valleys increased 5.0 percent per annum and 2.1 percent, respectively, between 1942 and 1950. Population growth in these areas surrounding Camp Cooke continued at a steady pace until the base's closing in 1953. With the reactivation of Camp Cooke in mid-1954, earlier growth rates resumed, with only moderate influence from the accelerated expansion of southern California in the 1950s (Crain and La Perrier, 1959).

A second major in-migration wave began with the coming of the missile age, marked by the 1957 transfer of Camp Cooke to the U.S. Air Force. Population grew even more rapidly than in earlier periods. In 1960-1970, the annual rate of population growth for Lompoc Valley equalled 5.3 percent yielding a population of 47,730 by 1970, while that for Santa Maria Valley was 3.6 percent, giving a figure of 56,630 persons by 1970.

More recent events, including the completion of most Vandenberg missile/space launch facilities, have led to population growth moderation. Lompoc Valley, in fact, lost about 4,000 residents over the 1970-1975 period, while Santa Maria Valley's population grew at only a 0.5 percent annual growth rate over the same period.



The development of medium to heavy industry, including aircraft manufacture, adjacent to the Santa Maria Public Airport during the late 1960s and early 1970s diversified and stabilized the area's economic base.

Environmental Characteristics of Vandenberg and Its Environs (1.2.2)

This section describes those characteristics of the environment which are representative of the potentially affected region surrounding Vandenberg Air Force Base which includes the base, Lompoc Valley, Santa Maria Valley and Santa Ynez Valley.

Physical Environment of Vandenberg and Its Environs (1.2.2.1).

Beginning with the land, this section describes the important features of the topography, geology, and soils of Vandenberg including stratigraphy, structure, geologic hazards, mineral resources, and paleontology, water-related aspects of the physical environment, meteorology and air quality and noise levels on the base and nearby communities.

Topography and Geomorphology (1.2.2.1.1). Vandenberg is located on the California coast just north of Point Conception, where the coastline changes aspect from south-facing to west-facing. Figure 1-16 is a composite of high altitude photographs of Vandenberg and its immediate environs. A large central portion of the hills is drained by Shuman Canyon Creek, an intermittent stream which crosses the northern part of the base. At the foot of the Casmalia Hills near the coast, there is a gently sloping coastal terrace with northwesterly trending linear sand-hills and intervening depressions, called the San Antonio Terrace which ranges in elevation from 50 ft (15 m) at the coast to 750 ft (229 m) inland. San Antonio Creek drains the central portion of the lowland. It occupies a narrow valley separating San Antonio Terrace on the north and Burton Mesa on the south. Burton Mesa is a gently sloping terrace with an elevation range similar to San Antonio Terrace. The Purisima Hills just east of Burton Mesa reach a maximum of 1,984 ft (605 m) in elevation. The southernmost feature of the Santa Maria district is the Lompoc Terrace. The Lompoc Terrace is similar in elevation to Burton Mesa and San Antonio Terrace, but is not as extensive, is more steeply sloping, and is cut by several canyons. South of Lompoc Terrace, the topography is dominated by rugged mountains and steep canyons that constitute the westernmost extension of the Santa Ynez Range.

Coastal topography is dominated by beaches, sand dunes, points with rocky shoals, sea cliffs, coastal terraces and mesas. From north to south, the Vandenberg coast exhibits the features described here. Point Sal is a rocky headland that extends over a mile (2 km) seaward.

Geology (1.2.2.1.2)

Faults. No major faults have been mapped within the Vandenberg area, although branch faults from major fault trends have been projected toward the area. None of these have been verified as tying into known faults on

the base. The only faults with significant displacement mapped on the base are the Lions Head fault, along the southern flank of the Casmalia Hills, and the Honda fault, in Honda Canyon on the north flank of the western Santa Ynez Mountains. Those two faults structurally bracket the northern and southern extremities of the Lompoc Lowland. Figure 1-18 identifies known fault branches. Other smaller faults associated with folds have been identified to the east of Vandenberg and to the north in the Casmalia Hills. On Lompoc Terrace, two faults mapped by Evenson and Miller (1963) have been called the Lompoc Terrace faults by Moore S. Taber (1974).

On the regional scale, there are three major faults, the North Branch and Pacifico faults, and the offshore Hosgri fault (Figures 1-17 and 1-18). The Santa Ynez fault trends east-west and the Hosgri fault trends north-northwest conforming to their respective physiographic provinces, the Transverse and Coast ranges. The Santa Ynez fault is the major tectonic dislocation in the Santa Ynez Mountains and marks the boundary between the Coast and Transverse ranges for much of its 80-mi (128 km) length. Figure 1-17 locates the large historic earthquakes in the region.

Layered cliffs of sedimentary rock and sharp twists due to faulting along the Santa Ynez fault and its active branches are clearly visible in the Santa Ynez Mountains that separate Santa Barbara County into the North County and the South Coast. Only two paved roads transverse these mountains.



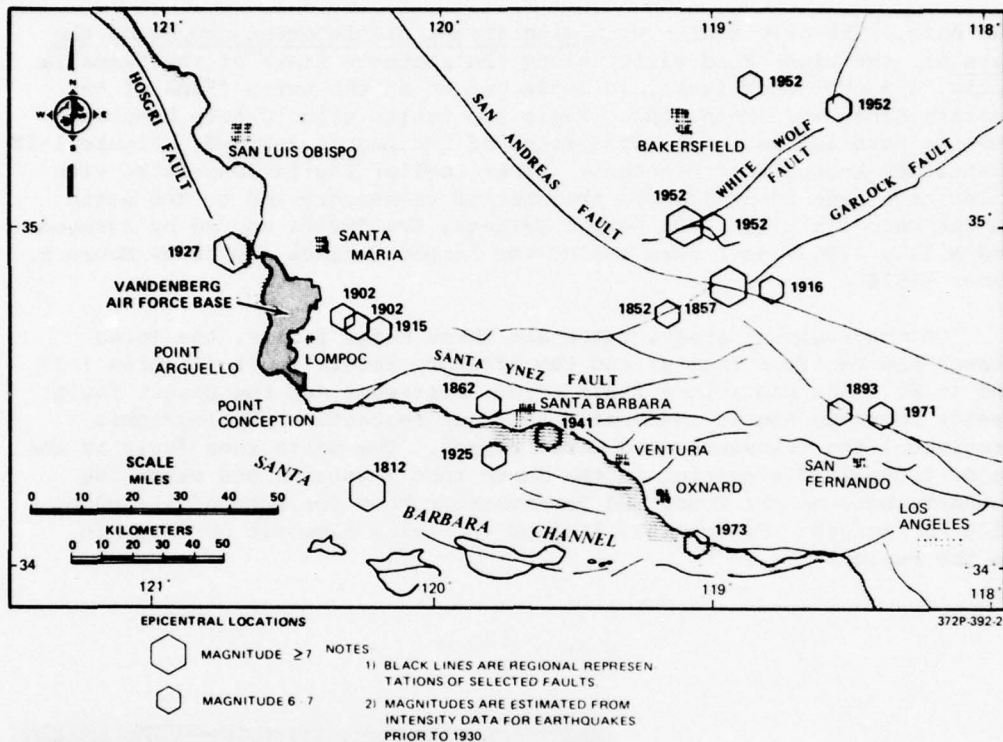


Figure 1-17. Location of large historic earthquakes in the region.

Seismic Hazards. Although seismographic records indicate that little earthquake activity has occurred in the Vandenberg area since 1932, the historic record shows that at least four damaging earthquakes occurred near Vandenberg between 1902 and 1927 (Townley and Allen, 1939). These earthquakes caused severe ground shaking in the area, illustrating that earthquakes are potential hazards to the facilities at Vandenberg. Figure 1-19 illustrates potential seismic hazards at Vandenberg.

Soil Creep and Landslide Hazard. Two types of downhill movement of soil and rock occur at Vandenberg; these are soil creep and landslides.

Soil creep can occur in most locations at Vandenberg where well developed soils, up to 4 ft (1.2 m) thick, exist on variable slopes with some incorporating steep bluff faces, the latter being subject to slippage if bedding planes are daylighted out of cut. Landsliding, primarily as a consequence of marine erosion, can be observed along the sea cliffs of the Shuman Canyon site. Structures with foundations below the soil mantle should not be affected by this very shallow phenomenon.

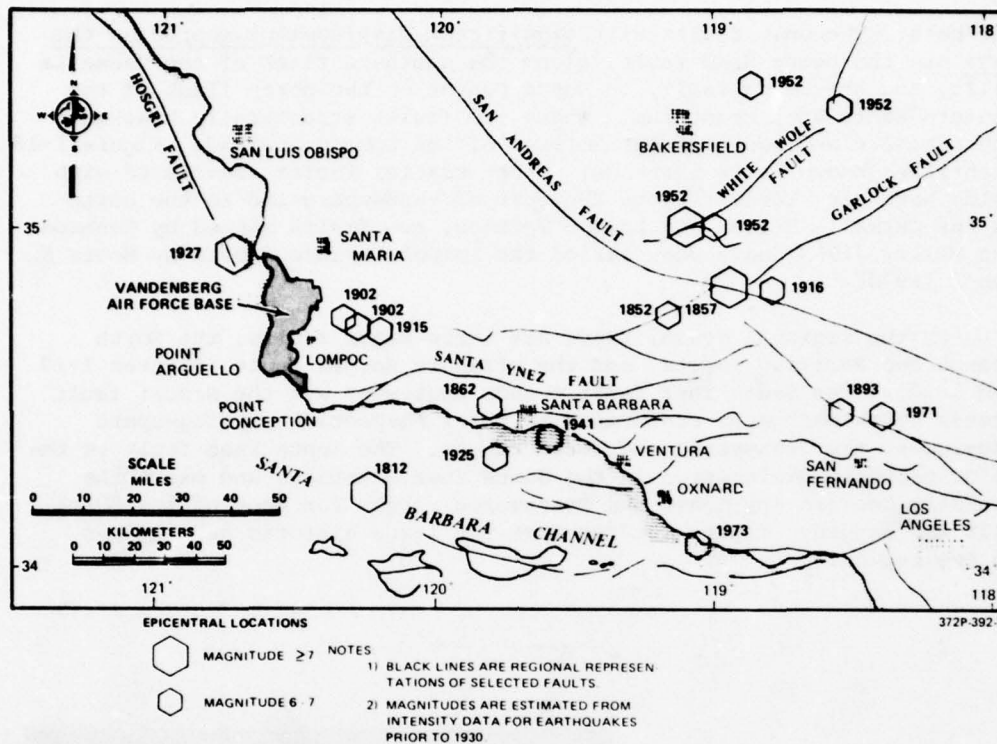


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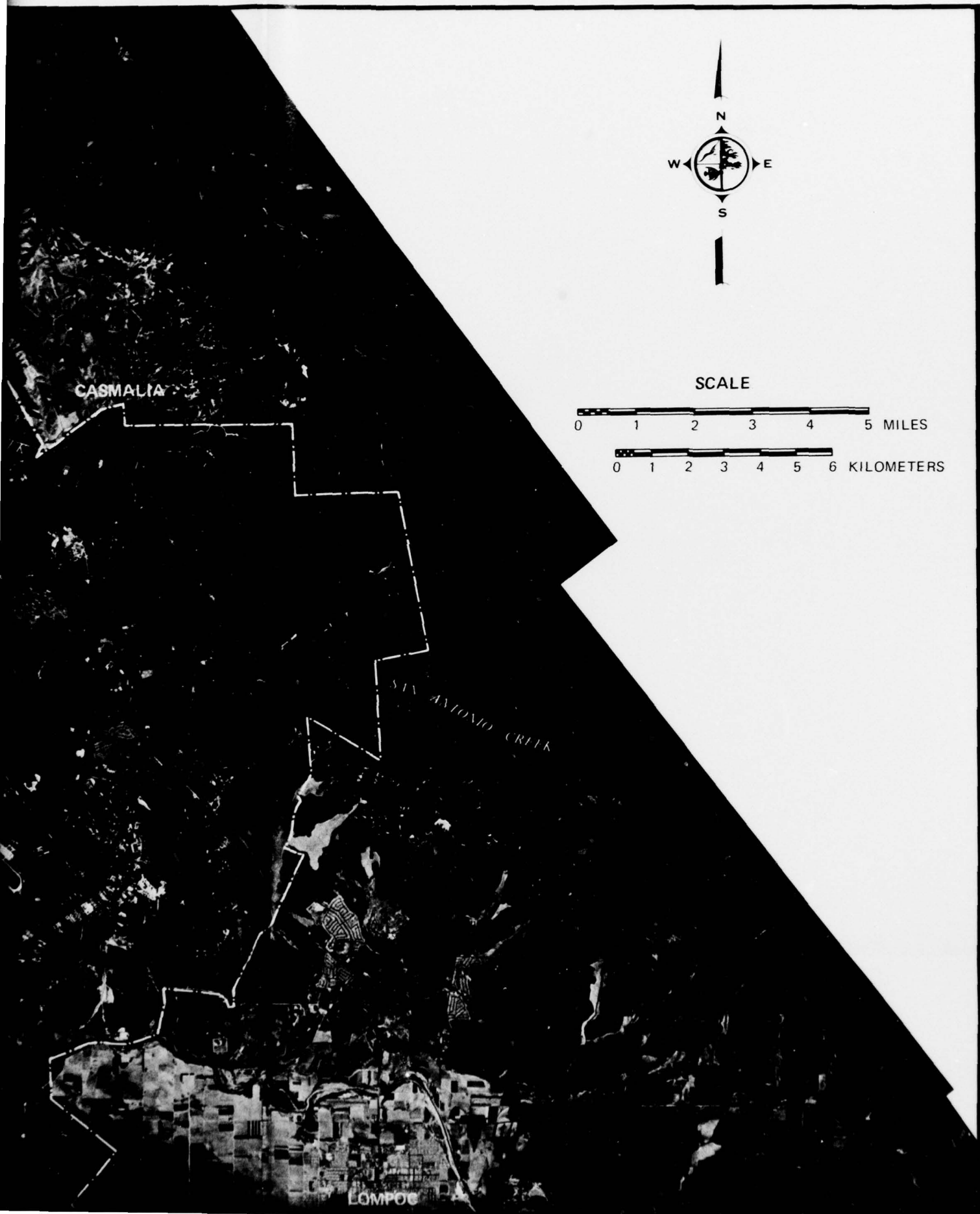
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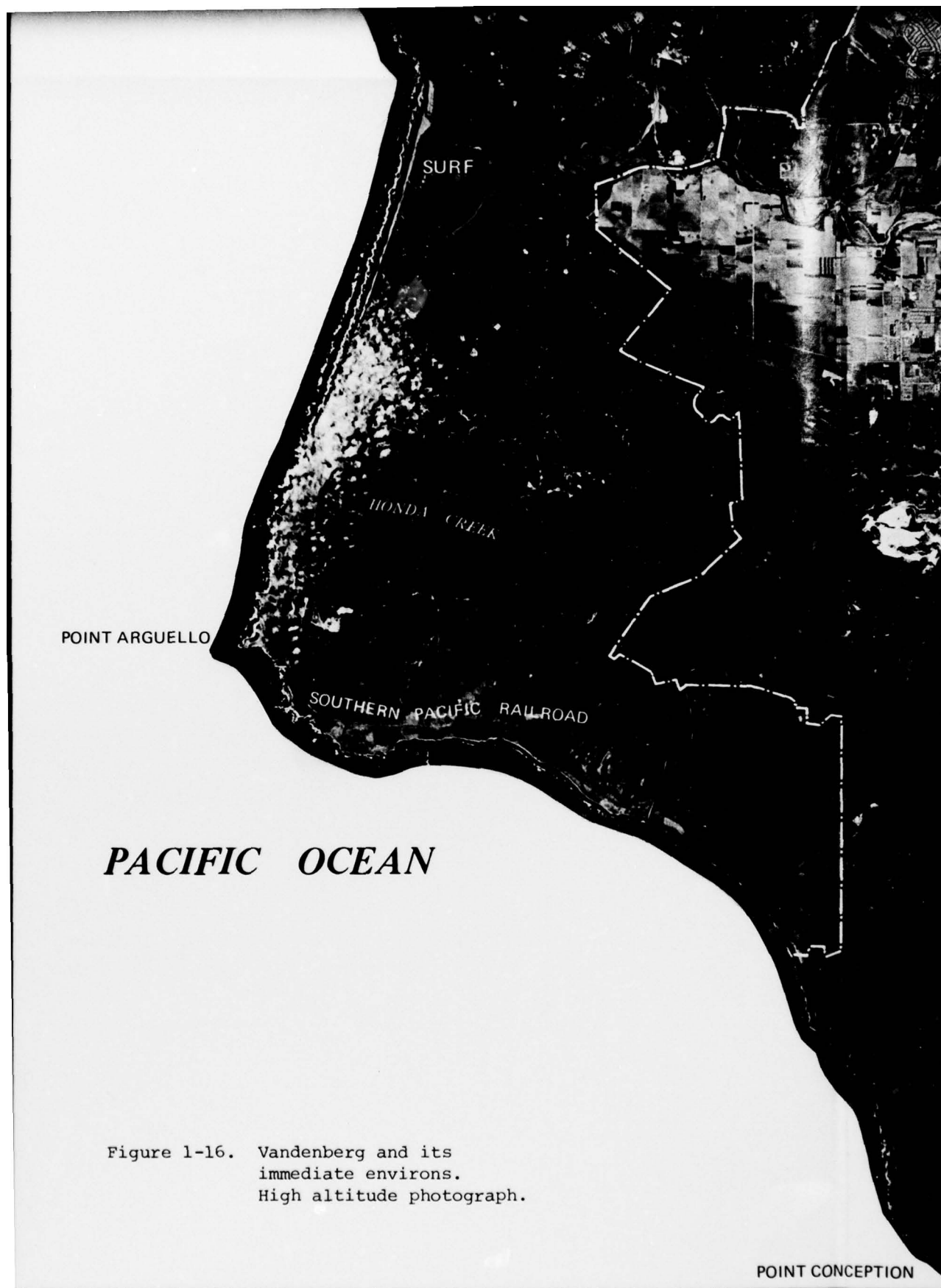
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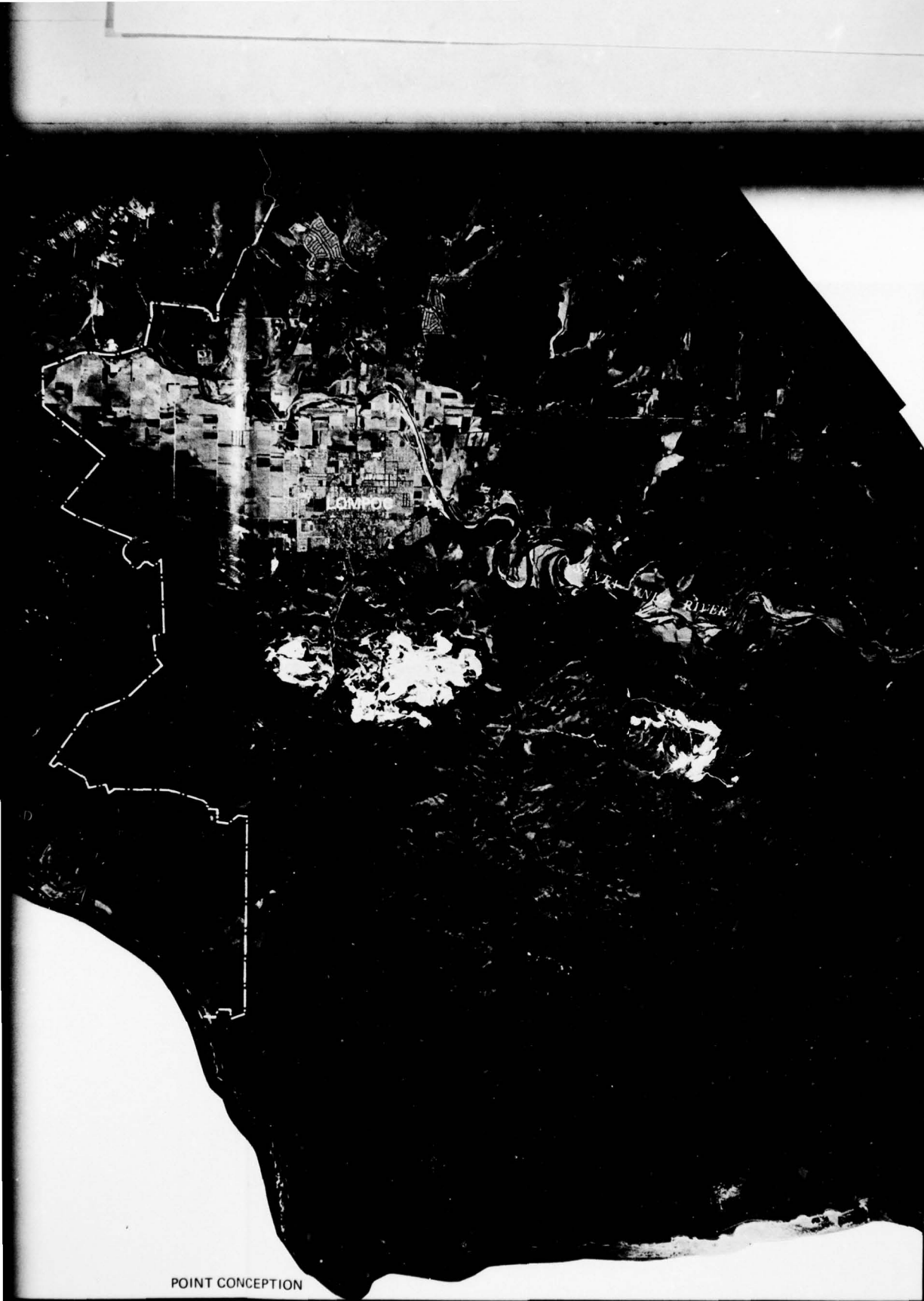




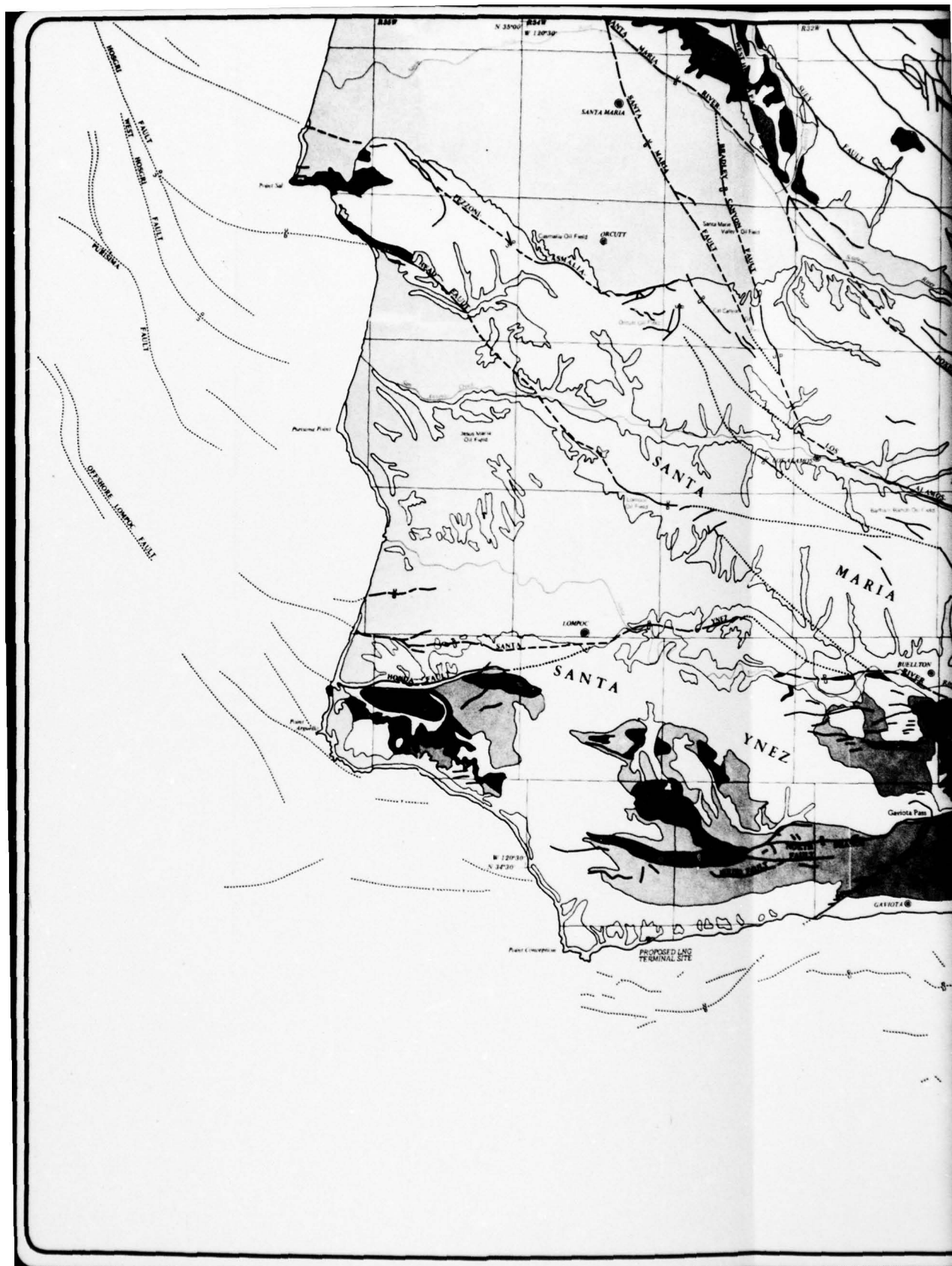
PACIFIC OCEAN

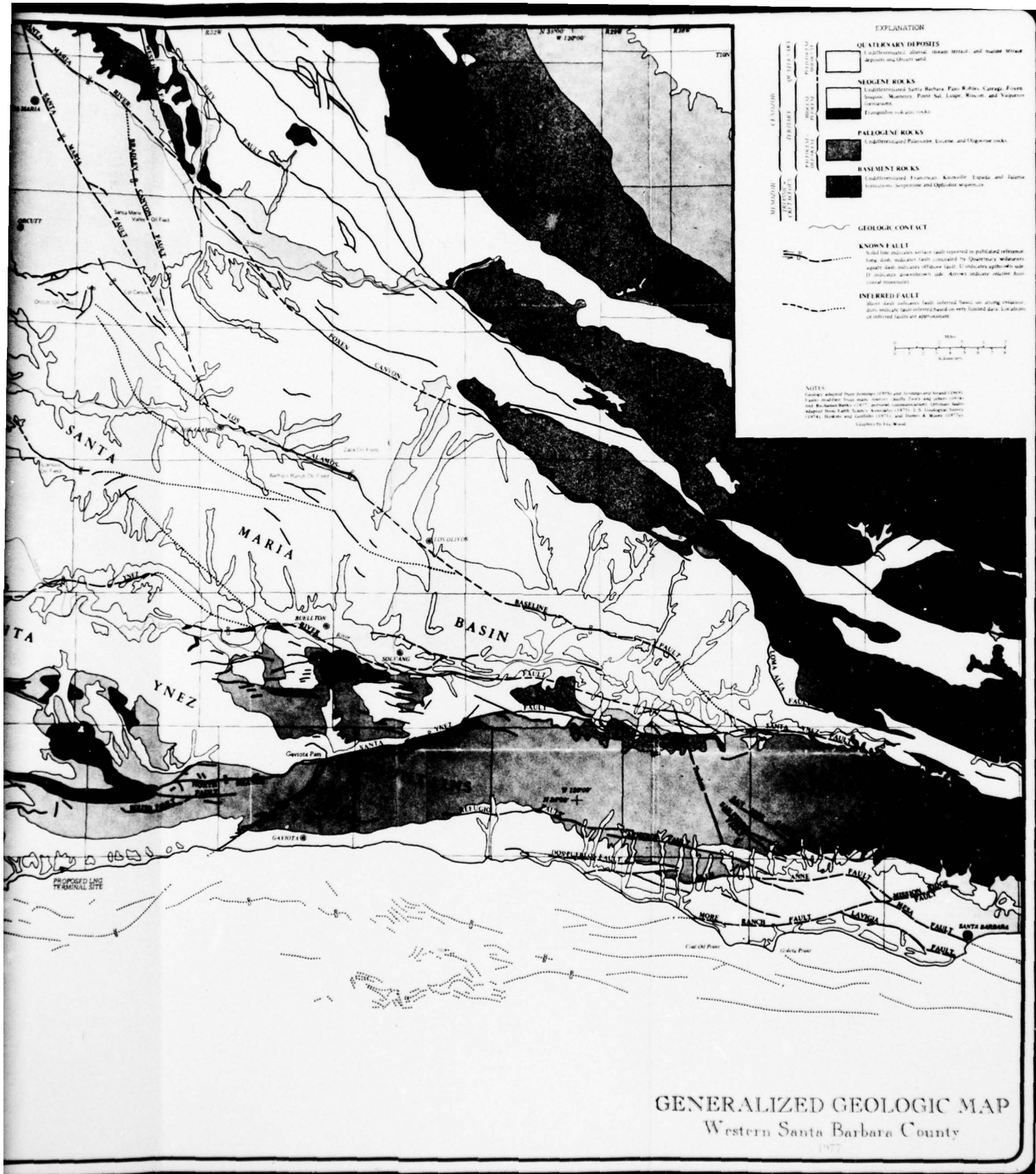
Figure 1-16. Vandenberg and its
immediate environs.
High altitude photograph.

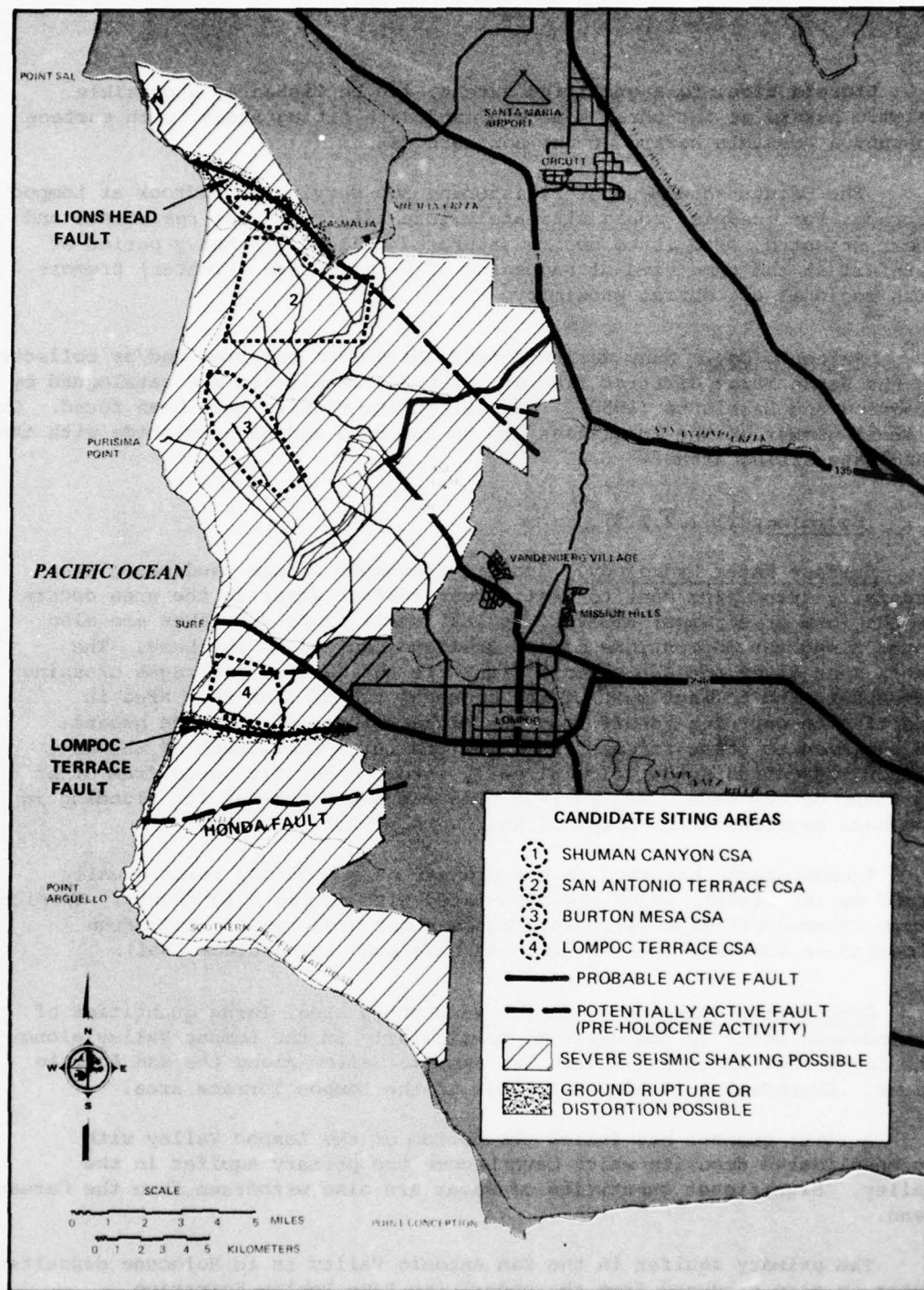
POINT CONCEPTION



POINT CONCEPTION







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Figure 1-19. Seismic hazards at Vandenberg AFB.

Liquefaction, to a qualified extent, may be listed as a possible seismic hazard at the three southern candidate siting areas, with surface rupture a possible hazard at the northern CSA.

The Orcutt sand of upper Pleistocene age serving as bedrock at Lompoc Terrace, for example, could ultimately lose all frictional resistance and shear strength, were it to become saturated following a heavy period of rainfall at the same time of happening of 6+ magnitude (Richter) tremors with regional epicentral proximity.

Paleontology. Many marine fossils have been observed and/or collected in the Santa Maria district from at least 263 localities and catalogued by Woodring and Bramlette (1950). Few vertebrate fossils have been found. Only a small number of the localities are on the base and none coincide with the candidate siting areas.

Hydrology (1.2.2.1.3)

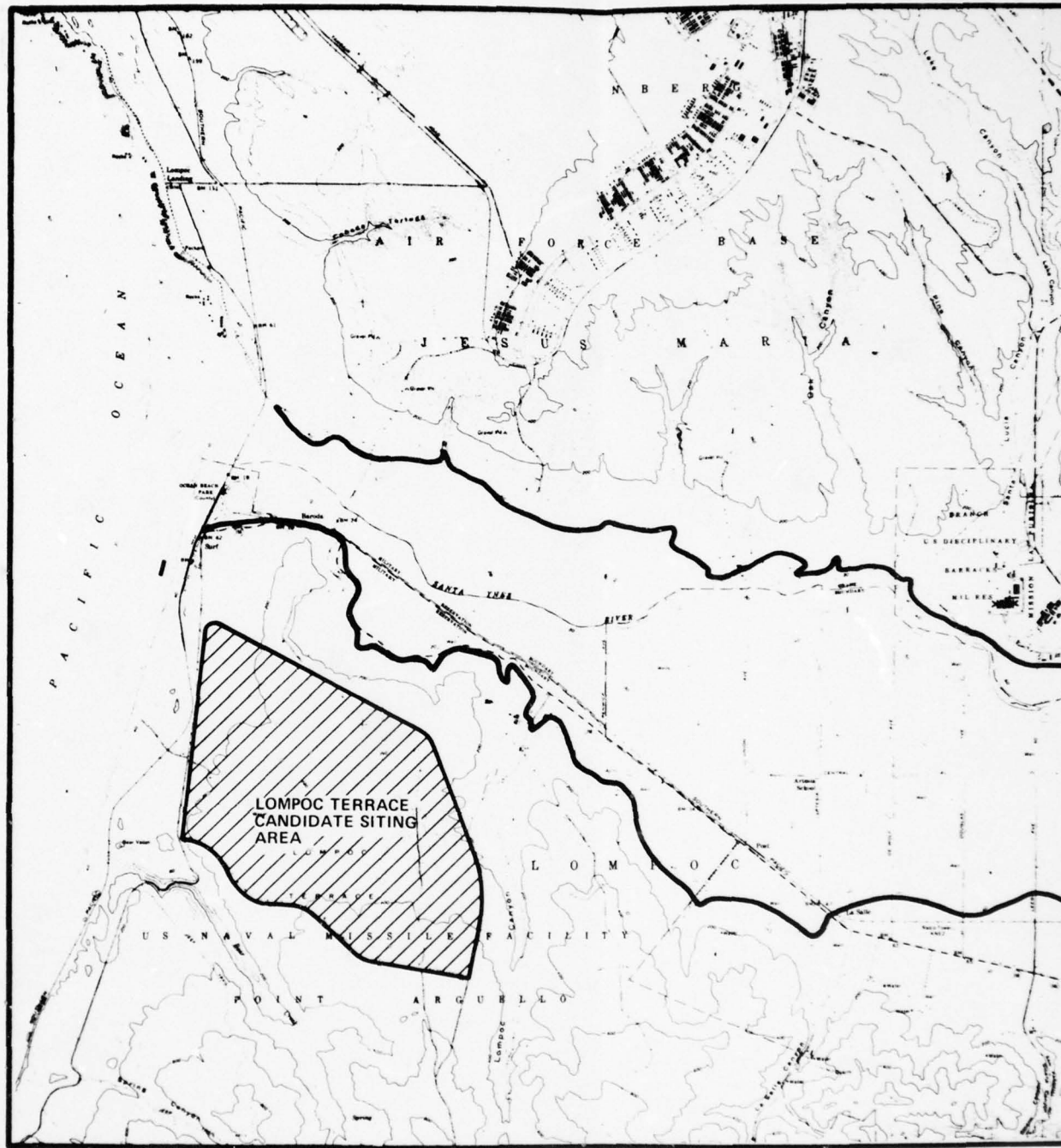
Surface Water Hydrology. Surface drainages in the Vandenberg area generally trend from east to west. Most surface water in the area occurs in the form of streams; however, several small ponds and lakes are also found along the depressions of old drainage courses on the base. The Santa Ynez River and San Antonio Creek are the largest drainages crossing Vandenberg and collect most of the seasonal runoff from this area in addition to carrying runoff from the higher, interior drainage basins. In addition to these streams, numerous smaller creeks, such as Shuman Canyon and Cañada Honda, flow directly into the Pacific Ocean from other portions of the base. Figure 1-20 presents the potential for flooding in the base environs (from Corps of Engineers, 1970).

Thunderstorms are rare in the project area. Steady rains usually occur during winter, which are associated with active cold fronts. Tropical storms formed off Baja California cause short high runoff, and often flooding in the area (weather records have been taken since 1951).

Groundwater Hydrology. In the Vandenberg area, large quantities of groundwater occur in the valleys, particularly in the Lompoc Valley along the Santa Ynez River and in the San Antonio Valley along the San Antonio River. Groundwater is also available in the Lompoc Terrace area.

A river channel has filled the bottom of the Lompoc Valley with unconsolidated deposits which have become the primary aquifer in the Valley. Significant quantities of water are also withdrawn from the Careaga sand.

The primary aquifer in the San Antonio Valley is in Holocene deposits; water is also produced from the underlying Paso Robles Formation.



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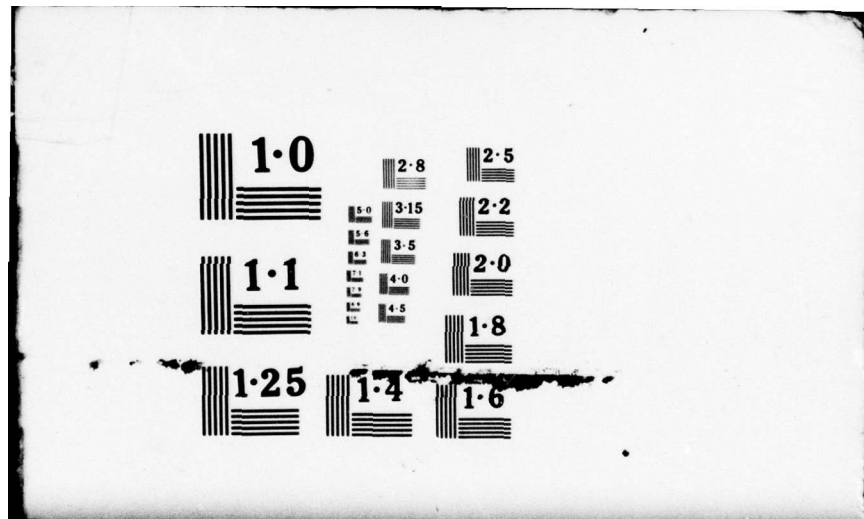
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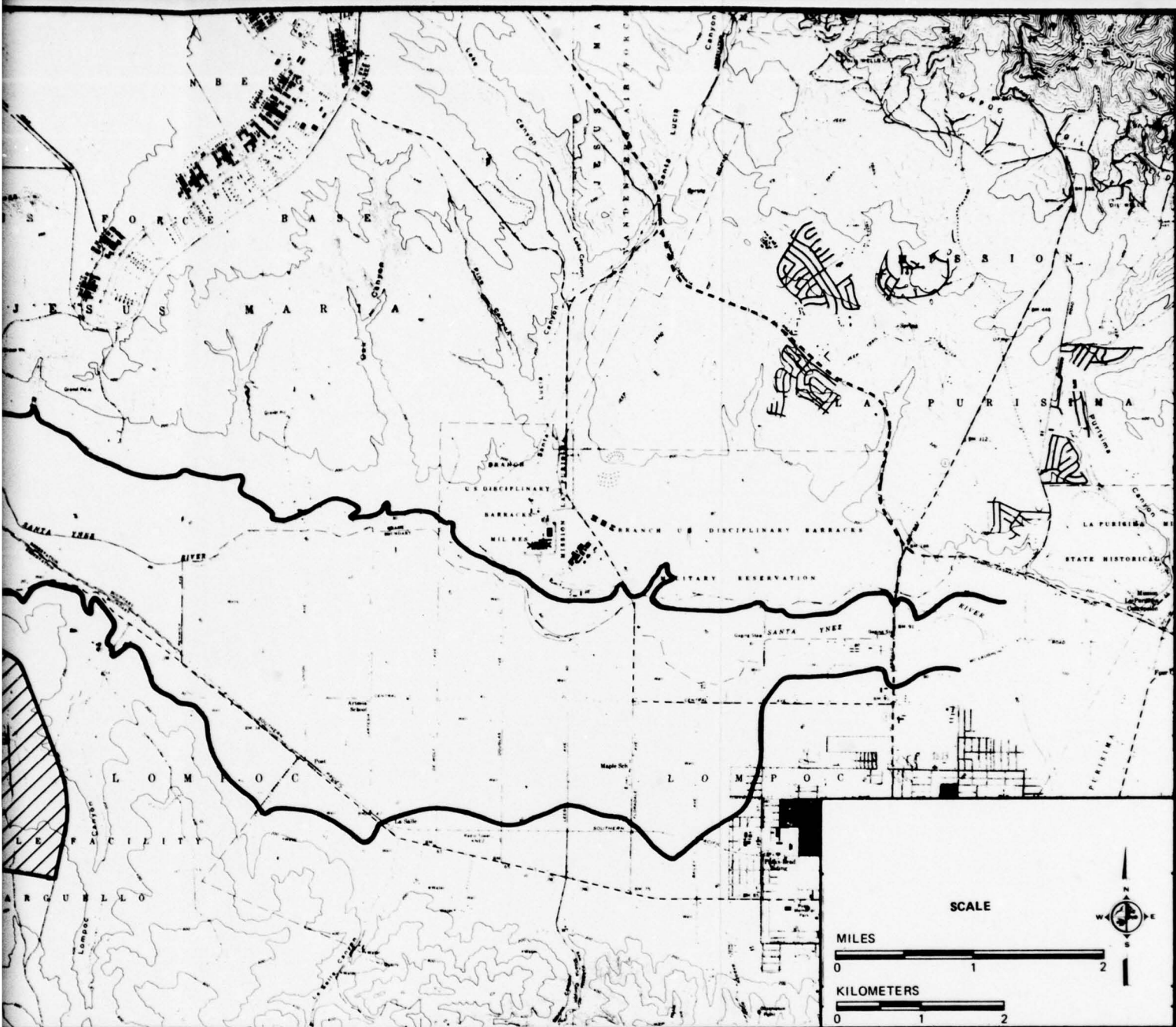
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Figure 1-20. The 100-year flood plain of the Santa Ynez River in the base environs.

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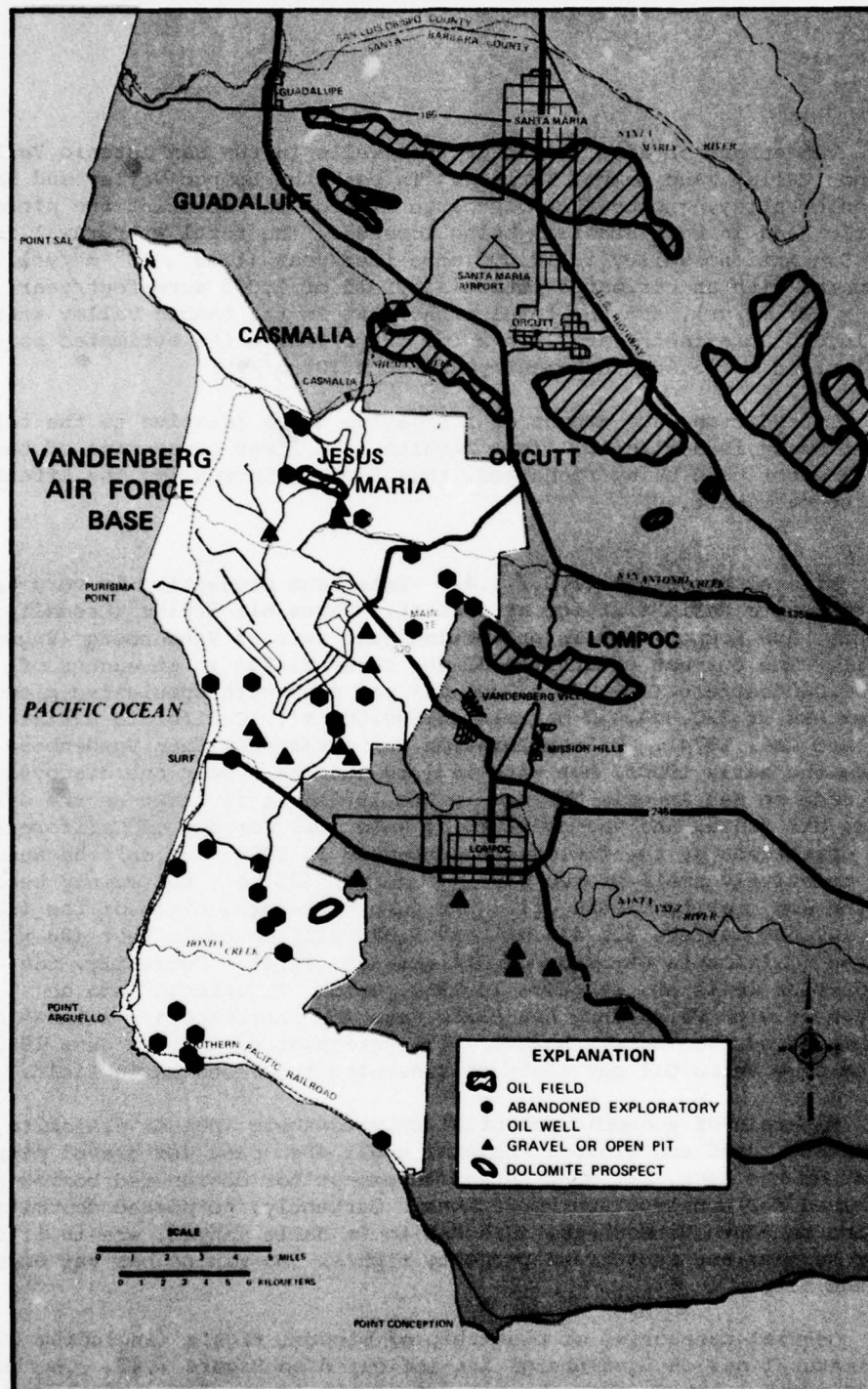
Vandenberg obtains its water from wells in the San Antonio Valley, Lompoc Valley, and Lompoc Terrace. In both the Lompoc Valley and San Antonio Valley, groundwater discharge exceeds recharge and the piezometric head in both areas is being lowered. The total withdrawal in the San Antonio Valley is 10,000 acre-feet/year ($12.3 \times 10^6 \text{ m}^3/\text{yr}$), compared with an estimated potential yield of 7,000 acre-feet/year ($8.6 \times 10^6 \text{ m}^3/\text{yr}$), and the total withdrawal in the Lompoc Valley area is 16,000 acre-feet/year ($19.6 \times 10^6 \text{ m}^3/\text{yr}$) while the estimated potential yield is 15,400 acre-feet/year ($18 \times 10^6 \text{ m}^3/\text{yr}$).

In addition, the amount of irrigation usage relative to the total water usage is declining. This results in a lower percentage of the total water used being recharged, thus further increasing the effects of the overdraft.

Mineral Resources (1.2.2.1.4). Petroleum production is very active in the Santa Maria district at present. Three oil fields (Casmalia, Orcutt, and Lompoc) are in production just east of Vandenberg (Figure 1-21). The current production of the three fields is in excess of 2,000,000 barrels ($318,000 \text{ m}^3$) of oil per year with cumulative production in excess of 220,000,000 barrels ($3,500,000 \text{ m}^3$) (California Division of Oil and Gas, 1974). Oil exploration has occurred within Vandenberg AFB since the early 1900s, but with limited success. Only one discovery was made on San Antonio Terrace in the 1950s; it is known as the Jesus Maria oil field, and was operated by Union Oil Company of California. Oil operations at the field were suspended in 1958, not only because of its relatively small proven size (70 acres) (28 ha), but mainly because of the low gravity of the oil. The cumulative production of the field was 147,669 barrels ($23,476 \text{ m}^3$) and 5,376 million cubic feet ($98 \times 10^6 \text{ m}^3$) of gas (California Division of Oil and Gas, 1974). Currently, the production wells are capped. In 1968, Union Oil entered into an agreement with Vandenberg Air Force Base for the temporary release of rights of surface entry; however, the agreement expires in June 1979 at which time Union Oil may elect to redevelop the Jesus Maria field.

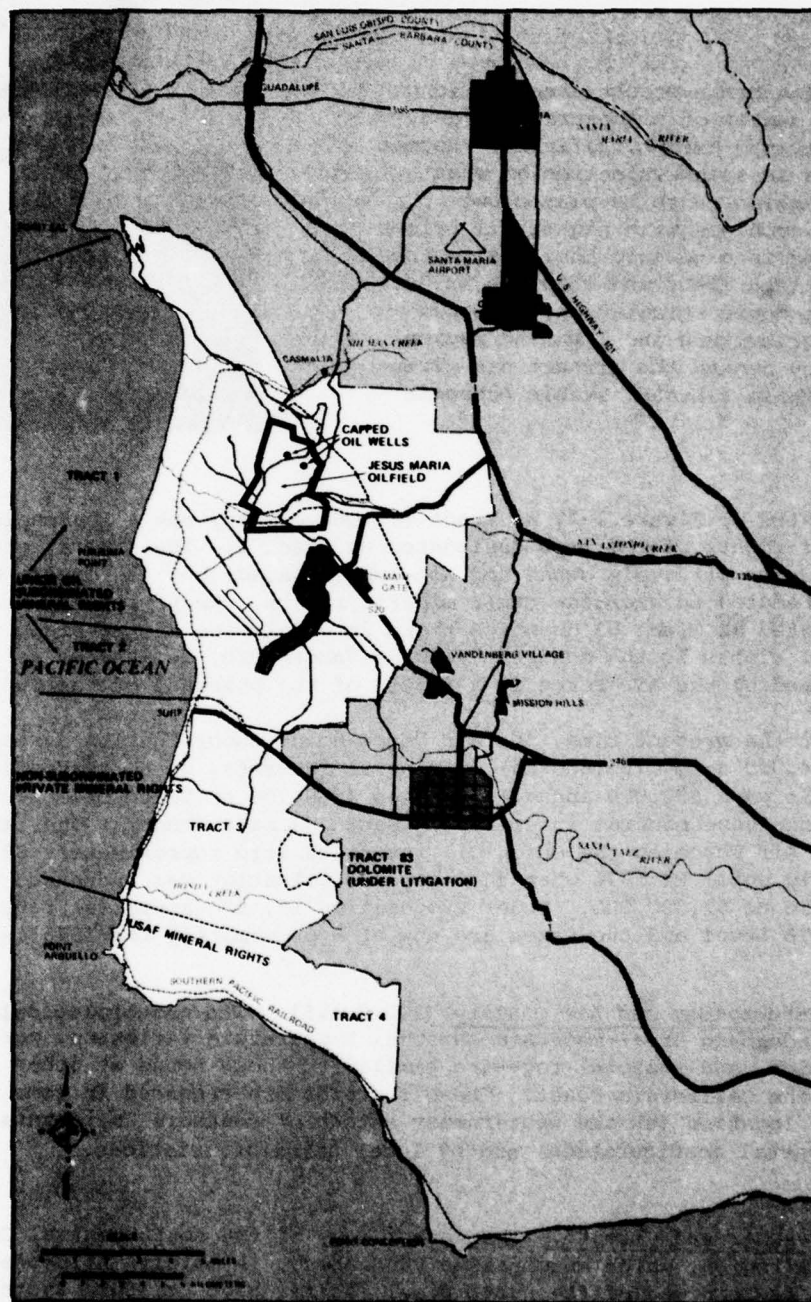
Minerals of economic potential on Vandenberg include diatomite, limestone, sand and gravel. Several small open sand and gravel pits exist on the base, but none is active except for designated borrow pits utilized for construction operations. Currently, purported dolomite claims on south Vandenberg, adjacent to La Salle Canyon, are in litigation over surface and subsurface property rights. No mining has yet occurred at the site.

General categories of ownership of mineral rights (including oil and natural gas on Vandenberg) are indicated on Figure 1-22. The Union Oil Company owns, in fee, the mineral rights in the large northern area



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Figure 1-21. Petroleum and mining of the Vandenberg region.



372P-840-1

Figure 1-22. Mineral rights ownership on Vandenberg AFB.

The Santa Maria-Orcutt area has long been a center of oil extraction and, to a limited extent, refining. Recent success in steam injection at what were considered to be played-out fields combined with higher oil prices resulted in a renewed boom during the mid to late 1960s and into the 1970s. This economic stimulation, combined with agriculture and light to medium industry around the airport has given Santa Maria a broad, stable economic base.



designated on Figure 1-22 as Tract 1. The company has a leasehold on the mineral rights of the area designated as Tract 2. The mineral rights in Tract 3 are privately owned and non-subordinated, but the owners have not attempted to exercise their mineral rights, except for the area designated as Tract 83 on which there is a dolomite mining claim. The mineral rights in the southern area of Vandenberg, designated as Tract 4, are owned by the Air Force as a result of the purchase of the Sudden Ranch.

At the present time, the Air Force holds subordination agreements over 64,000 acres (25,600 ha) of mineral interests on North Vandenberg for which it pays \$88,000 annually in fees (\$68,200 to Union Oil) plus property taxes on those mineral interests in Santa Barbara County. The taxes paid by the Air Force on the Union Oil interests were approximately \$5,000 annually until FY 1976 when the assessed valuation was increased from \$259,450 to \$2,300,000. Under Proposition 13, the appraisal reverted to the 1976 level and the taxes are now at approximately the 1976 level.

Meteorology and Air Quality (1.2.2.1.5). The meteorological features of the Vandenberg area—moderate seasonal temperature variation, maritime inversion, and seasonal fog—are similar to those found at other locations along the California coast. These features are enhanced in some measure by the location (at the westernmost extent of southern California), by the coastal configuration, and by local terrain variations.

Weather and Climate. The meteorology of the south central California coastal region, which encompasses Vandenberg, is mainly influenced by the stable eastern end of the subtropical Pacific high pressure system. In

winter this high pressure system moves south and stable, moist maritime air dominates the region. The winter or wet season extends from November through April. The mean monthly and annual precipitation for Vandenberg is shown on Table 1-10.

Daily solar heating of the land surface warms the layer of air adjacent to the ground. Light, warm air moves aloft and is replaced by cool, denser air from over the ocean, starting a sea breeze. The layer of air over the ocean is kept cool and dense by the cool ocean surface. This results from the interactions of the deep penetration of solar radiation, cold ocean currents, and upwelling. As solar heating over the land continues, the localized wind movement from the ocean to the land increases and the flow penetrates farther inland. This sea-breeze regime reaches a maximum intensity in the late afternoon and begins to deteriorate in the early evening. The average wind speed of a fully-developed sea breeze is between 5 and 15 knots (3 to 8 m/sec). The height to which this wind field penetrates is generally less than 1,500 ft (457 m) and rarely extends farther inland than 30 mi (48 km).

The general large-scale seasonal circulation pattern on which is superimposed the localized sea breeze pattern produces a wind field with a resultant directional component between the west and northwest.

Table 1-10. Precipitation statistics for the period January 1958 to July 1974.

MONTH	MEAN MONTHLY PRECIPITATION		MONTH	MEAN MONTHLY PRECIPITATION	
	(IN.)	(mm)		(IN.)	(mm)
January	2.52	64.0	July	0.01	0.3
February	2.57	65.3	August	0.04	1.0
March	2.00	50.8	September	0.18	4.6
April	1.37	34.8	October	0.62	5.7
May	0.13	3.3	November	2.00	50.8
June	0.06	1.5	December	1.81	46.0
			Annual	13.31	338.1

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Source: Det. 30, 2nd Weather Squadron, Vandenberg AFB.

Figure 1-23 shows the average wind field streamlines for the month of July between the hours of 1200 and 1800 PST. The average afternoon wind field streamlines for the month of January are similar. There is very little directional change in the daytime wind fields from season to season.

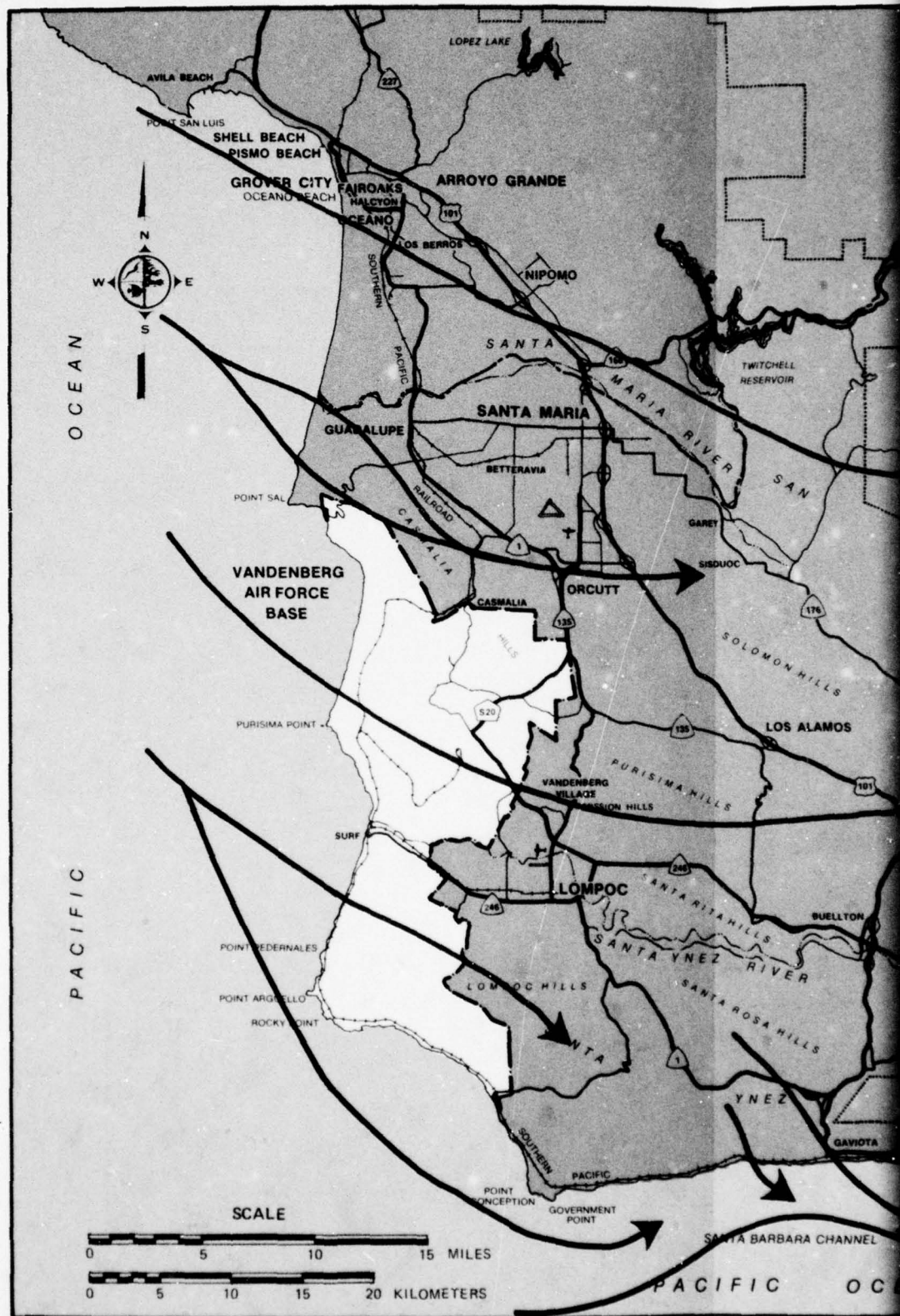
A land breeze develops in the coastal regions of southern California at night. Its magnitude and importance are less than the sea breeze. Figure 1-24 shows the land breeze flowing counter to the general circulation pattern. This occurs during late night and early morning hours especially during the winter.

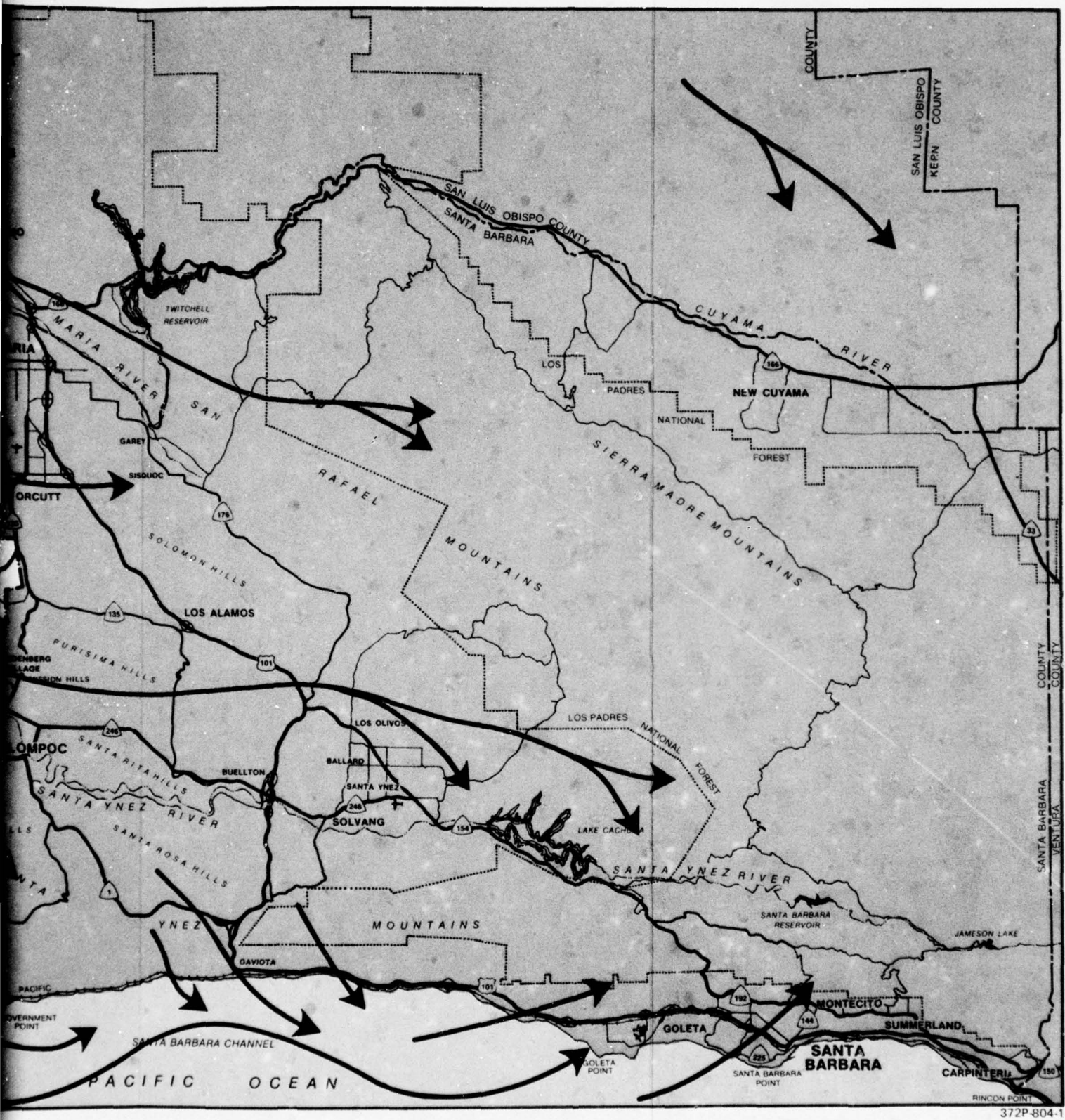
Air within the subtropical Pacific high pressure system has a peripheral descending or subsiding motion which causes an inversion to develop along the coastal area of central and southern California. This type of inversion is due to the mean downward motion of the air on the eastern side of the high. The air warmed by this mechanism eventually finds a resting place atop the cool marine layer. This situation is common during the summer with the inversion base averaging 1,200 ft (367 m) above the surface in the Vandenberg area. In the winter and at night, the inversion is somewhat lower.

- Wind. Surface winds at Vandenberg vary considerably from one location to another due to terrain, time of day, and season. The prevailing wind direction February through November is the northwest, with east-southeasterly winds prevailing during December and January. Wind gusts as high as 41 knots (21 m/sec) have been recorded at the airfield in January and February (see Table 1-11).

Wind direction is largely governed by the presence of a land or sea breeze. These diurnal winds are generally confined to the coastal regions but strongly influence local Vandenberg weather. The land and sea breeze flow is illustrated in Figures 1-23 and 1-24. Winds in some areas are subject to velocity increases due to the channelling effect of valleys. Northwest winds blowing over high portions of the south base also result in high wind speeds. Wind gusts at Tranquillon Peak have been recorded at 70 to 80 knots (36 to 41 m/sec).

The drying Santa Ana wind regime occasionally reaches the Vandenberg area bringing high temperatures, low humidity, and extreme gustiness. Fire danger often becomes very high during these periods.





372P-804-1

Figure 1-23. Afternoon wind patterns, southern California, July III-73

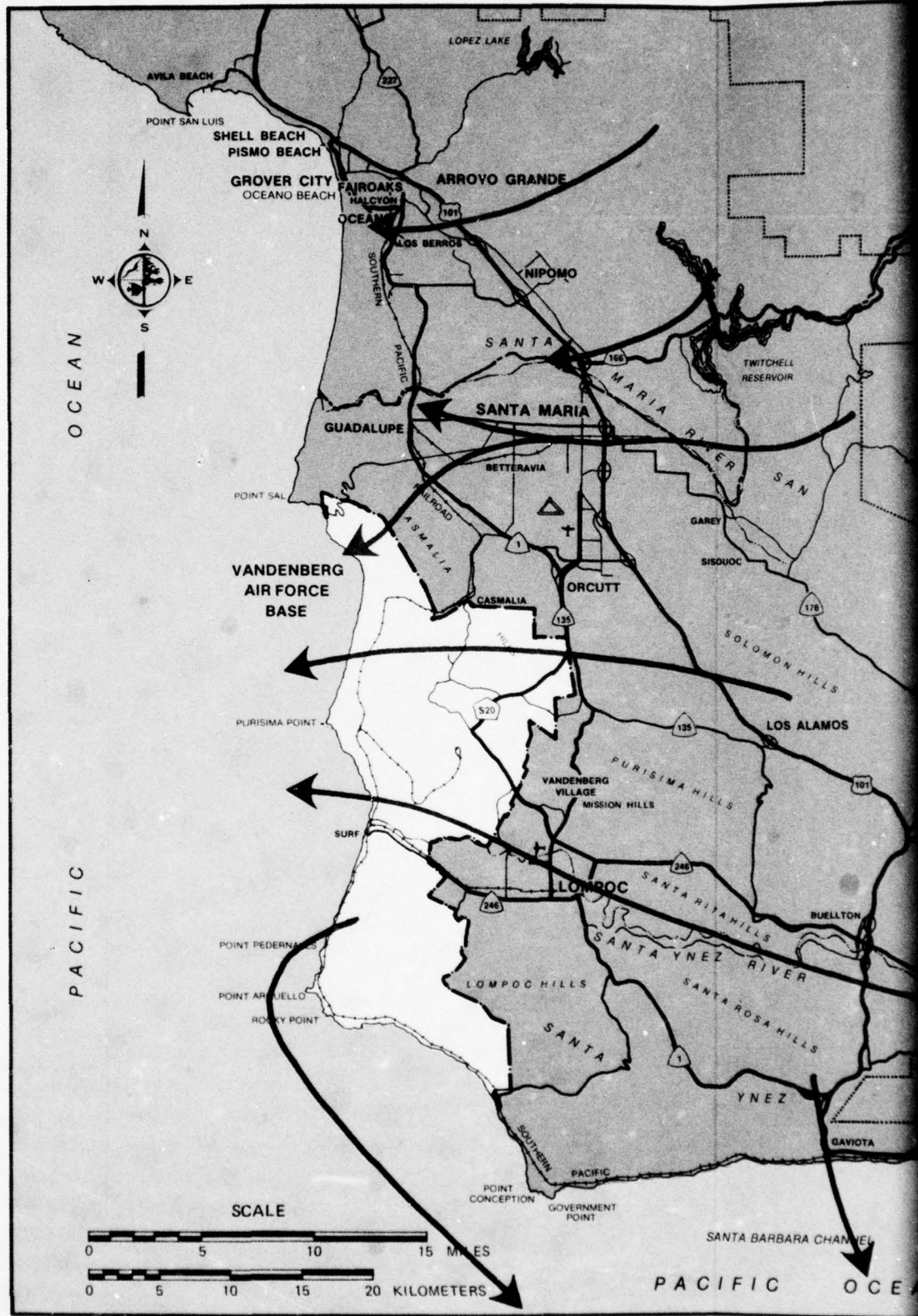


Table 1-11. Summary surface wind data for the period January 1958 through July 1974.

MONTH	MOST FREQUENT DIRECTION	MEAN VELOCITY		MAXIMUM GUST	
		(KTS)	(m/sec)	(KTS)	(m/sec)
January	ESE	6.2	(3.1)	41	(21)
February	NW	6.5	(3.3)	41	(21)
March	NW	7.5	(3.9)	40	(21)
April	NW	7.3	(3.8)	40	(21)
May	NW	7.7	(4.0)	35	(19)
June	NW	6.4	(3.3)	36	(18)
July	NW	5.0	(2.6)	28	(14)
August	NW	4.8	(2.5)	28	(14)
September	NW	4.9	(2.5)	32	(16)
October	NW	5.4	(2.8)	35	(18)
November	NW	5.9	(3.0)	38	(20)
December	ESE	5.8	(3.0)	38	(20)
Annual	NW	6.1	(3.1)	41	(21)

372T-3011

Source: Det. 30, 2nd Weather Squadron, Vandenberg AFB.

- Temperature and Humidity. Mean monthly temperatures at Vandenberg (Table 1-12) show little variation. The relative uniformity of the temperature is attributable to the latitude of Vandenberg, its proximity to the ocean, and the presence of a mountain barrier. Average maximum temperatures range from 60° F (16° C) in March, to 69° F (21° C) in October.

The mean annual relative humidity recorded at the Vandenberg airfield is 77 percent.

- Fog. The terrain at Vandenberg plays a major role in determining the occurrence of fog. The frequency of fog is greater in the regions that are relatively flat and closer to the coast. For this reason, the northern and western portions of the base have more fog and low stratus than the more rugged

Table 1-12. Temperature statistics for the period between January 1958 and July 1974.

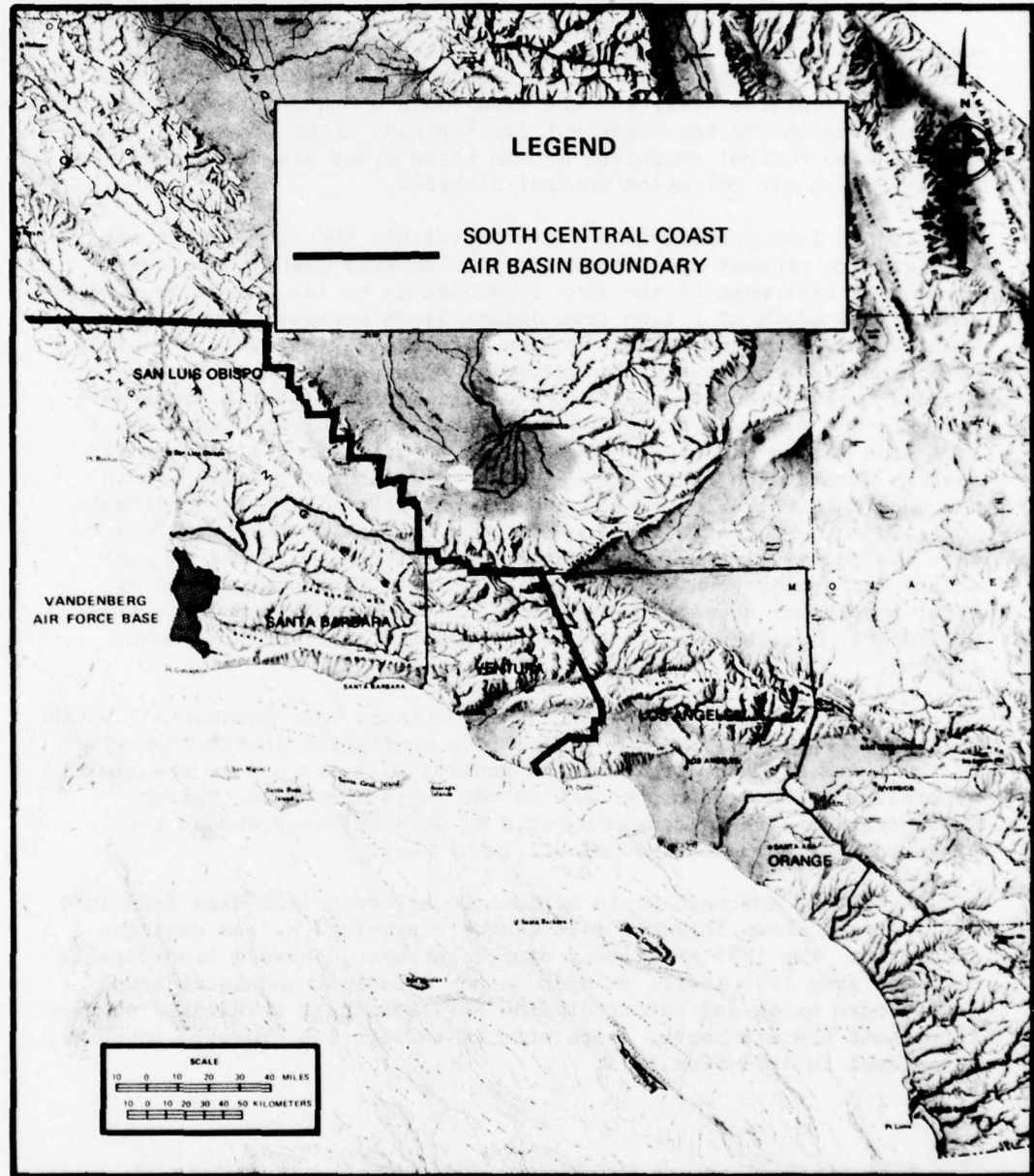
MONTH	MEAN MONTHLY TEMPERATURE	
	(°F)	(°C)
January	52	(11)
February	53	(12)
March	53	(12)
April	53	(12)
May	55	(13)
June	57	(14)
July	59	(15)
August	60	(16)
September	61	(16)
October	60	(16)
November	56	(13)
December	53	(12)
Annual	56.0	(13.3)

372T-3012

Source: Det. 30, 2nd Weather Squadron, Vandenberg AFB.

terrain of the southern and eastern sections of Vandenberg. There is a strong delineation between shoreline and inland areas also, with the frequency of fog occurrence decreasing inland with increasing distance from the cold coastal waters.

Regional Air Quality and Emissions. Vandenberg falls within the South Central Coast Air Basin which includes the counties of Santa Barbara, San Luis Obispo, and Ventura (Figure 1-25). The three counties comprise the three Air Pollution Control Districts (APCDs) in the air basin and cooperate in establishing emission control regulations. Ventura County and the South Coast of Santa Barbara County were added in June 1976, when the California Air Resources Board redefined the South Central Coast Air Basin to include these areas which had formerly been in the South Coast Air Basin (CARB, 1977).



372P-892-2

Figure 1-25. South Central Coast Air Basin.

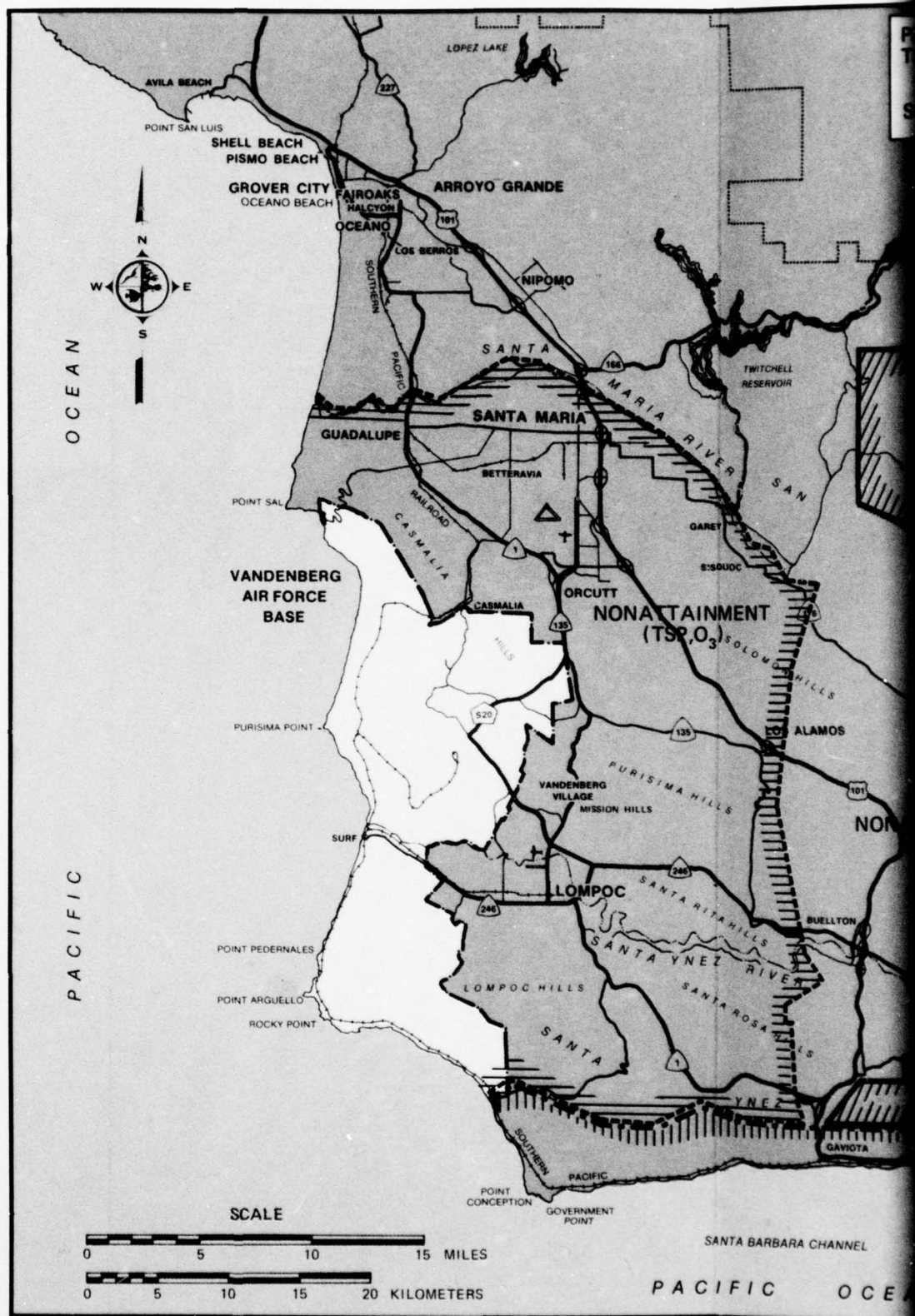
All of Santa Barbara County has been designated as an oxidant nonattainment area for emission control purposes. The western portion of the county has been designated nonattainment for total suspended particulates (TSP) and the area south of the Santa Ynez Mountains has been designated nonattainment for TSP and carbon monoxide. Specific plans to control emissions within these areas are being developed by the County Air Pollution Control District.

Figure 1-26 presents the divisions within the county that are pertinent to present and future emission control plans. The nonattainment area west of the line from Gaviota to Los Alamos to Sisquoc and the one south of a line from Jalama Beach eastward along the mountain ridge to the Ventura County line are subject to air quality management and the county is developing plans for both of them. National prevention of significant deterioration criteria are applicable in the Class II area (Los Padres National Forest) and Class I area (San Rafael Wilderness Area) which mandate fixed limits on air quality within each class area. Vandenberg, since it falls within the nonattainment area for suspended particulates (TSP) and oxidants (O_3), is subject to the requirements for control of these pollutants that the County Air Pollution Control District establishes as part of its management plan. The plan is currently being developed by local government agencies and groups including representatives from Vandenberg, but the specific control criteria have not yet been adopted.

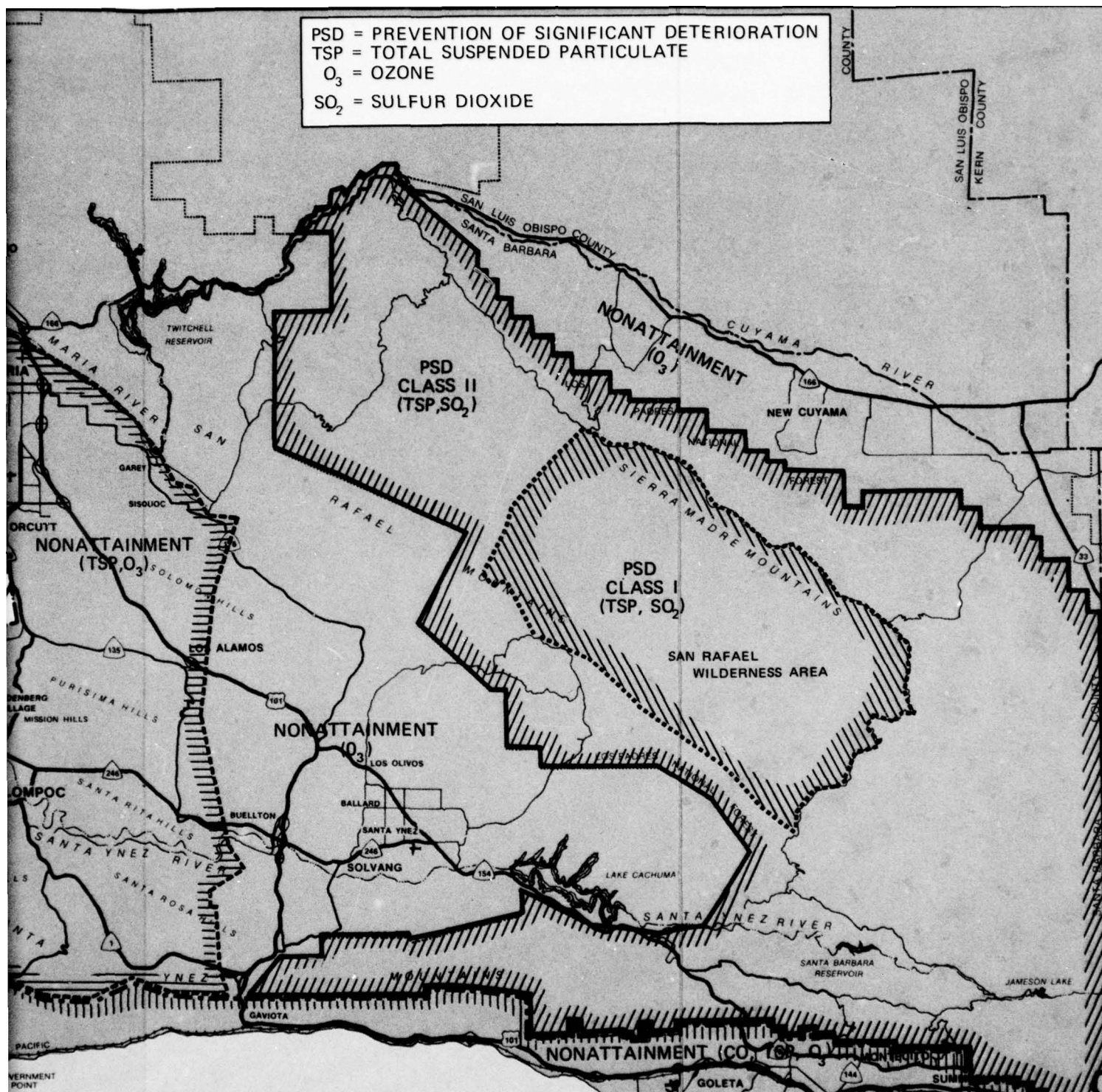
In Santa Barbara County north of the Santa Ynez Mountains ("North County"), two of the ambient air quality monitoring stations operated by the Santa Barbara Air Pollution Control District are in the area generally downwind from the base in the Santa Ynez River Valley. These stations are in Lompoc about 4 mi (6.4 km) away and at the Santa Ynez Airport about 20 mi (32.2 km) away.

Available northern Santa Barbara County emissions data from 1973 and 1975 are shown in Table 1-13 and were provided by the agencies indicated. The 1975 stationary source inventory shows a considerable decrease from 1973 levels in hydrocarbon emissions and an increase in nitrogen oxide and sulfur dioxide emissions from stationary sources throughout the air basin. Both effects reflect the improved inventory data level in 1975 over 1973.

Base Air Quality and Emissions. The overall air quality at Vandenberg can be characterized by all pollutant concentrations remaining below air quality standards with the exception of total

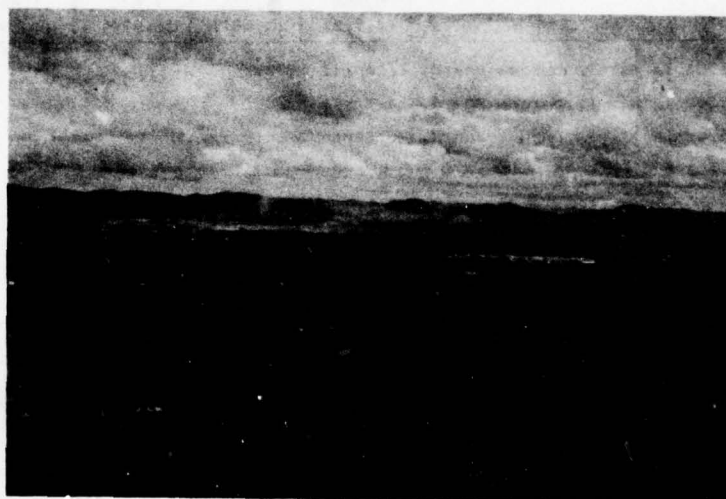


PSD = PREVENTION OF SIGNIFICANT DETERIORATION
TSP = TOTAL SUSPENDED PARTICULATE
O₃ = OZONE
SO₂ = SULFUR DIOXIDE



suspended particulates and ozone which exceed the standards on certain occasions. Local emissions sources are the controlling factor in establishing air quality. At Vandenberg, emissions have been inventoried, but few air quality measurements are made; therefore, only preliminary air quality data are available from within the Vandenberg boundaries.

Mobile and stationary source emissions at Vandenberg are tabulated in Table 1-14 for 1975 and 1976. The vehicle emissions for the year 1975 were used to compute the combined mobile and stationary sources for both 1975 and 1976, since no vehicle emissions inventory update was performed in 1976. The increases in stationary emissions figures reflect small changes in most of the source categories and the addition of stationary diesel power plant sources to the inventory.



The photograph above is typical of the expansive, low density, agriculture in Santa Maria, Lompoc, and Santa Ynez valleys that constitute the Vandenberg AFB environs. Above is a view of the Santa Maria Valley looking northeast from Casmalia Road, the least traveled link between Vandenberg AFB and surrounding residential areas. On-shore sea breezes in the Santa Maria and Lompoc valleys have a cleansing effect upon local air quality but increase pollution in valleys farther inland, including the Santa Ynez Valley.

Table 1-13. Emissions inventory for northern Santa Barbara County (including Vandenberg AFB).

SOURCE CATEGORY AND YEAR	EMISSIONS [tons (tonnes)/year]				
	CO	HC	NO _x	SO ₂	PART.
Mobile Sources					
1973 ¹	25,623 (23,240)	4,088 (3,708)	3,212 (2,913)	183 (166)	402 (365)
1975 ²	25,003 (22,678)	3,906 (3,543)	3,249 (2,947)	183 (166)	402 (365)
Stationary Sources					
1973 ¹	694 (629)	4,672 (4,238)	1,752 (1,589)	1,205 (1,093)	2,482 (2,251)
1975 ³	nd ⁴	1,152 (1,045)	3,026 (2,745)	7,447 (6,754)	1,461 (1,324)
Combined Mobile and Stationary Sources					
1973	26,317 (23,870)	8,760 (7,945)	4,964 (4,502)	1,388 (1,259)	2,884 (2,616)
1975	—	5,058 (4,588)	6,275 (5,691)	7,630 (6,920)	1,863 (1,690)

¹California Air Resources Board, 11 April 1978.

²California Air Resources Board, 4 April 1978

³California Air Resources Board, 26 September 1977.

⁴No data collected.

3/21/3013.1

Table 1-14. Emissions inventory for Vandenberg AFB.

SOURCE CATEGORY AND YEAR	EMISSIONS [tons (tonnes)/year]				
	CO	HC	NO _x	SO ₂	PART.
Mobile Sources					
1975 ¹	870 (789)	90 (82)	45 (41)	1.7 (1.5)	6.0 (5.4)
Stationary Sources					
1975 ²	8.5 (7.7)	369.1 (334.8)	48.3 (43.8)	1.8 (1.6)	7.4 (6.7)
1976 ¹	57.7 (52.3)	387.0 (351.0)	282.5 (256.2)	17.0 (15.4)	21.9 (19.9)
Combined Mobile and Stationary Sources					
1975	878.5 (796.8)	459.1 (416.4)	93.3 (84.6)	3.5 (3.2)	13.4 (12.2)
1976 ³	927.7 (841.4)	477.0 (432.6)	327.5 (297.0)	18.7 (17.0)	27.9 (25.3)

¹Vandenberg.

²SAMSO, 1976.

³Includes 1975 emission data for mobile sources.

3/21/3014.1

The data in Tables 1-13 and 1-14 for north Santa Barbara County and Vandenberg show that all base-generated emissions constitute less than 10 percent of the North County totals for each type of pollutant. Carbon monoxide from mobile sources and hydrocarbons, primarily evaporative losses from fuel storage, are the two largest emissions, representing 9.4 percent and 5.2 percent respectively of the North County emission totals in 1975.

Noise (1.2.2.1.6). Onbase, activity which produces noise is directly associated with the operation of the base, namely automobile traffic, truck traffic, aircraft landings and takeoffs, and missile firings. In the communities adjacent to the base, the onbase activity which produces noise is almost entirely automobile and truck traffic. Railroad traffic is a significant noise source both on and off the base.

In recent years, there have been no complaints recorded concerning noise produced by missile launches. This can be attributed to the infrequent launches and the low annoyance level of rocket engine firings.

Existing Noise Levels. The Community Noise Equivalent Level (CNEL) is an averaged (A-weighted) sound level for a 24-hour period (day). Due to increased human sensitivity during evening and nighttime hours, an additional 5 dB, evening, and 10 dB, night time, sound level restriction is added to the normal noise level limits. Evening is defined as from 7:00 to 10:00 P.M. (1900 to 2200) and night time from 10:00 P.M. to 7:00 A.M. (2200 to 0700). No single study has produced a CNEL contour map for all of Vandenberg and its surrounding communities. However, three individual studies have been performed. The studies are of the city and valley of Lompoc (Van Houten, 1974), Vandenberg air operations (USAF, 1978), and the Santa Maria airport (BBN, 1973). Minuteman and Titan III launchings provide maximum A-weighted sound pressure levels comparable to, or in excess of, levels from automotive and aircraft traffic.

Estimated CNEL contours for the Lompoc Valley are shown in Figure 1-27. Noise impact areas (shaded) basically parallel the major transportation arteries and the Vandenberg runway approach path. Noise impact areas are defined as areas with a CNEL of 65 dB or higher. The 70 and 75 CNEL contours are found only very close to major highways (up to 20 ft (6.1 m) from the centerline). The 65 CNEL contours are usually found 100 ft (30.5 m) from the centerline of heavily travelled highways.

This pattern of CNEL contours is estimated to be the same in other urban areas around Vandenberg as highways through all incorporated areas are very similar and the population densities are roughly the same for all communities.

Annual traffic volume at Lompoc Airport (takeoffs and landings, excluding touch-and-go operations) was estimated at about 15,300 operations in 1975. Operations at the two civilian airports do not cause significant noise impact for their respective communities. Specifically, a noise study for the Santa Maria Airport showed that the dB CNEL contour was entirely within the boundaries of the air field (BBN, 1973).

Aircraft operations in the restricted air space over Vandenberg are of low volume. According to the U.S. Department of Transportation, the number of aircraft operations at the Vandenberg landing field totaled only 3,600 in 1977. Nevertheless, enough of the aircraft are high noise producers to create an average CNEL environment of approximately 55 dB for the population housed on the base. In addition, the various flight tracks, especially the southern approach over Lompoc, raise the CNEL in the Lompoc area to over 50 dB.

The population noise exposure has been estimated from the CNEL contour information. This estimate is in terms of the fraction of population in 5 dB wide CNEL bands from 45.50 dB to 70.75 dB. The results of the base and surrounding communities are presented in Table 1-15.

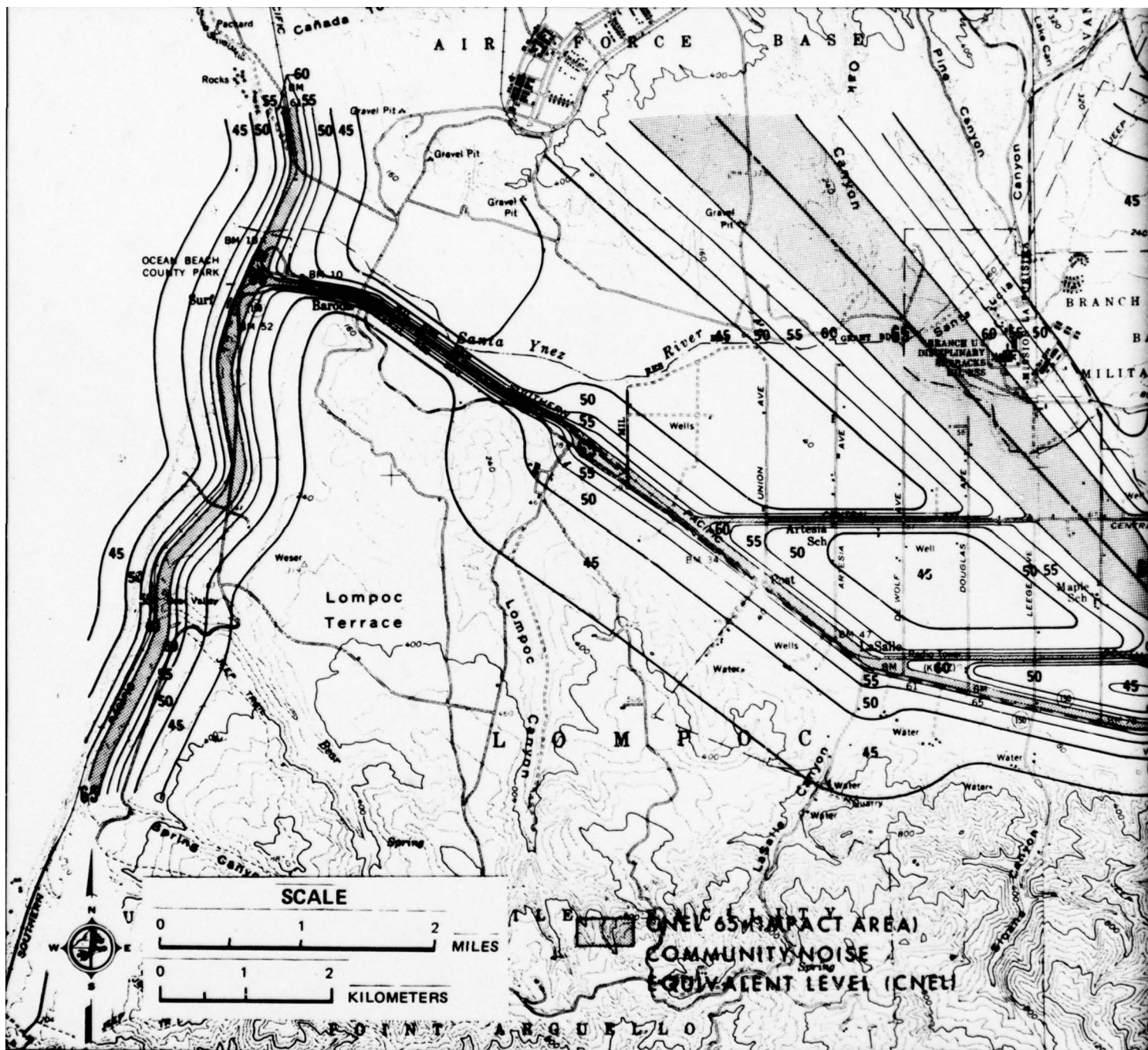
Table 1-15. Existing noise impact.

COMMUNITY	POPULATION	LWP ¹	NII ²
Santa Maria	33,900	5,639	0.17
Orcutt	20,300	3,278	0.16
Lompoc	19,000	3,548	0.19
Vandenberg AFB	13,600	2,524	0.19
Vandenberg Village	6,500	1,144	0.18
Guadalupe	3,800	709	0.19
Mission Hills	3,000	528	0.18
FCI	1,700	672	0.29
Casmalia	200	74	0.367
Total	103,000	18,135	0.174

372T-3015

¹LWP - Noise Level Weighted Population.

²NII - Noise Impact Index.



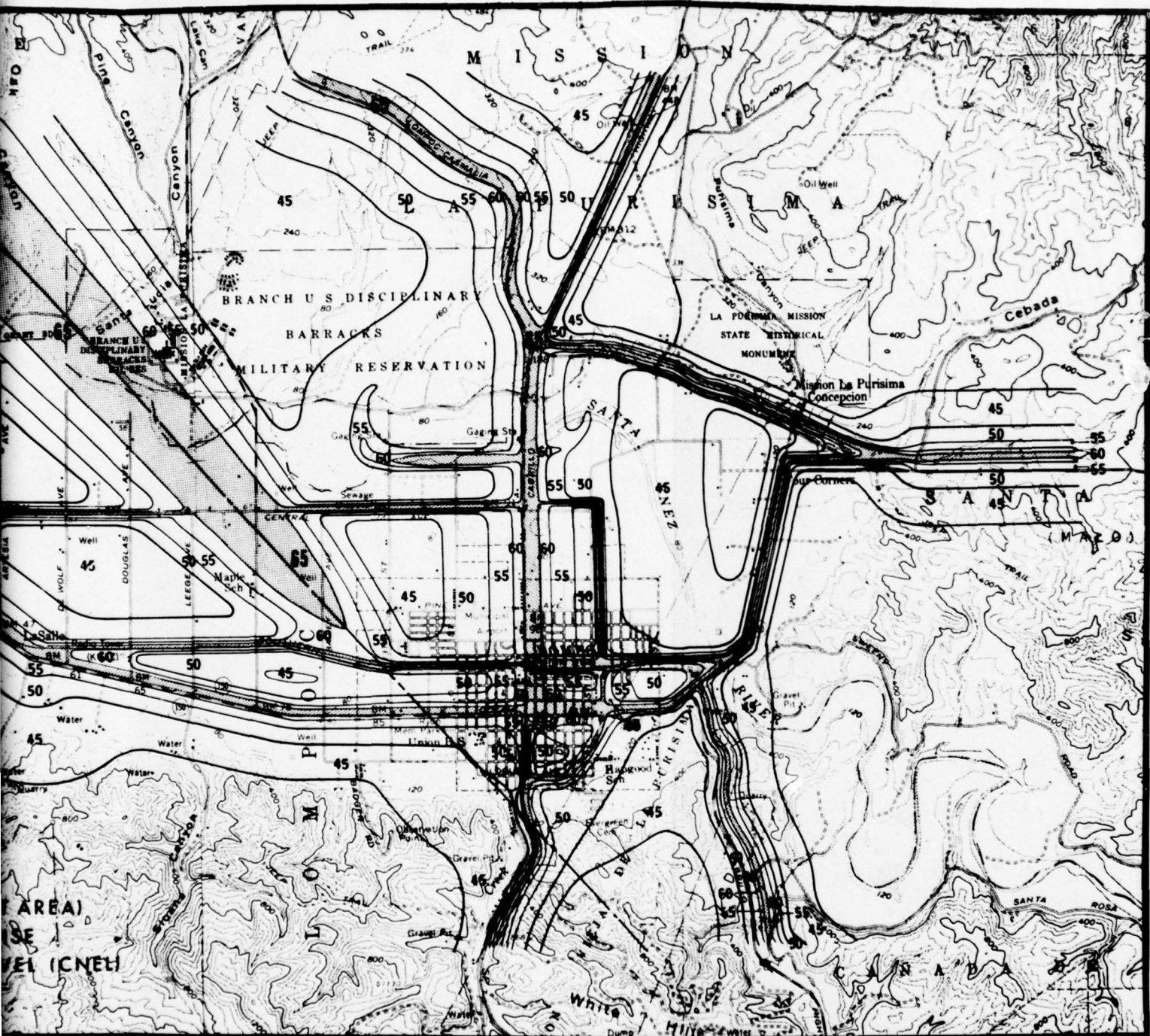


Figure 1-27. Lompoc Valley Community Noise Equivalent Levels.

The sound level weighted population (LWP) for each community was calculated by multiplying the total population times the fraction exposed, times the weighting function for the particular CNEL band, and then summing. The noise impact for each community, and for the total population, are also presented.

The Noise Impact Index (NII) is a standard which takes into account the number of people exposed to noise. Impact of individual noise levels are considered greater in high density areas and less important in areas of lower density.

Biological Environment of Vandenberg and Its Environs (1.2.2.2). Much of Vandenberg Air Force Base has long been relatively isolated and inaccessible to the public due to the security measures required for a military base. As a result, the base contains intact representations of habitat types that have been reduced in areal extent or highly disturbed in other coastal areas of California by increased urbanization and recreation demand. These habitats on the base serve as a refuge for several rare plant and animal species.

The coastline of Vandenberg begins just north of Point Conception, a major feature of the California coastline. Point Conception separates the west-facing central California coast, with its exposure subjecting it to the full force of winter storms from the Gulf of Alaska, from the more protected south-facing coastline of the Santa Barbara Channel. Due to its isolation, the coastline of Vandenberg has remained relatively undeveloped with the exception of the military facilities and past and present agricultural and grazing uses.

Vandenberg has a history of cattle grazing dating back to the Spanish occupation that is typical of California coastward of the major north-south mountain axis (Cismontane California). Wildlife on Vandenberg is relatively abundant for the types of habitats represented and is typical of similar cismontane California habitats. The vegetation on VAFB has unique aspects and contains isolated remnant occurrences of species and communities which marked their greater geographic extent during the Pleistocene or earlier geological time (relictual elements). In addition, the base has assemblages of plant species which appear to have adapted as communities to a peculiar local set of conditions.

The prevailing feature of the landscape is dry grass- or brush-covered flatlands or hills. Only on north-facing slopes, in arroyos, and along the widely separated streams or rivers are trees found; evergreen oaks in the former situations, willows and other streamside vegetation in the latter. Typical of central and southern California, there are few streams reaching the ocean with perennial surface flow. However, underground water in many water courses supports a thicket of vegetation which adds resources of food and cover to wildlife.

Terrestrial Wildlife (1.2.2.2.1). Representative common vertebrate species on Vandenberg are mule deer, coyote, bobcat, occasional mountain lion, jack-rabbits, cottontails, skunks, ground squirrels, and a diverse assemblage of nocturnal rodents. Reptiles and amphibians are not particularly abundant or conspicuous (with the exception of the ubiquitous small fence and side-blotched lizards) but include gopher snakes, king snakes, Pacific rattlesnakes, the Pacific treefrog, western toad, and Eschscholz's and slender salamanders. A peculiar burrowing snake-like lizard, the California legless lizard, is found in sandy soils on Vandenberg. Perhaps the most conspicuous land birds are the raptors including red-tailed hawks, sparrow hawks (American kestrel), and white-tailed kites which are visible almost everywhere over the flatlands. Other land birds including meadowlarks, crows, blackbirds, sparrows finches, mockingbirds, and mourning doves are also common. Shore birds are abundant in kind and in number at the water's edge on sandy beaches. Queues of California brown pelicans flying along the coast are becoming a common sight. Gulls, cormorants, and terns are also conspicuous in flight or while feeding.

Animal Species Protected by Federal or State Law. This section discusses laws pertaining to the protection of animal species and briefly analyzes the distribution and biology of species protected by federal or state law which possibly occur on Vandenberg.

The federally protected species that may be affected by activities at Vandenberg are therefore examined in compliance with Section 7 of the Endangered Species Act of 1973. In addition, attention is paid to those species at Vandenberg that are listed as endangered or rare by the California Endangered Species Act of 1970, or are otherwise fully protected by provisions of the California Fish and Game Code. These species are:

California condor	<i>Gymnogyps californianus</i>
Bald eagle	<i>Haliaeetus leucocephalus</i>
American peregrine falcon	<i>Falco peregrinus anatum</i>
Brown pelican	<i>Pelecanus occidentalis</i>
Light-footed clapper rail	<i>Rallus longirostris levipes</i>
California least tern	<i>Sterna albifrons browni</i>

Examples of potential Vandenberg species in three California categories of "endangered," rare and fully protected are: Belding's savannah sparrow (*Passerculus sandwichensis beldingi*); California black rail (*Laterallus jamaicensis coturniculus*); California yellow-billed cuckoo (*Coccyzus americanus occidentalis*); golden eagle (*Aquila chrysaetos*); and white-tailed kite (*Elanus leucurus*).

California condor, *Gymnogyps californianus*. This huge, black vulture with white underwing patches and bare orange head is North America's largest land bird, having a wing-span of over 2.7 m (9 ft). A relict of the Ice Age, the California condor once ranged over much of western North America from British Columbia to Baja California. The present range is shown in Figure 1-28.

The condor forages over mountains, grasslands, and savannahs (especially large ranges) for carrion. Most birds nest and roost in the Sespe Wildlife Area of Los Padres National Forest, Ventura County, and forage northwards into the southern foothills of the Sierra Nevada in Kern and Tulare counties. Some birds from the Sespe Wildlife Area also move towards Santa Barbara, San Luis Obispo, and Monterey counties. Condors reportedly have nested within 50 mi (80.4 m) to the north of Vandenberg and in the past have occurred through the Santa Ynez Range. A smaller group roosts and moves northwards from Santa Barbara County, sometimes as far north as Santa Clara County.

Bald eagle, *Haliaeetus leucocephalus*. The bald eagle is classified as an endangered species on both the federal and California lists. The bald eagle formerly ranged the length of California, breeding from the northern portions south to San Clemente Island. It was a resident of several of the Channel Islands until about 1960. The bald eagle no longer nests on any of the coastal islands of California and now breeds only in a few localities in the northern part of the state. Although its range still includes the length of California, it is considered to be an uncommon winter visitor from October until April. Small numbers winter on the larger lakes and reservoirs in southern California. One to four have wintered at Lake Cachuma in Santa Barbara County in 8 of the 11 years prior to 1972. One was reported at Ventura, 16 November 1968; one at Ventura County Game Preserve, 19 January and again on 18 March 1970; and one at Santa Barbara Bird Refuge, 9 November 1971.

Although the bald eagle is not expected to occur at Vandenberg, it is possible that its flights during winter may distribute individuals to the shores or lakes on the base.

American peregrine falcon, *Falco peregrinus anatum*. This endangered species is now extinct as a breeding bird east of the Rocky Mountains. In California, it formerly bred along the sea coast, on offshore islands, and in the higher mountains inland. Today, there are fewer than five known viable eyries in the entire state. One of these is on Morro Rock on the coast of San Luis Obispo County, where the California Fish and Game Commission has established the Morro Rock Ecological Reserve for the peregrine falcon and has placed it under surveillance. In the 1940s, the breeding population in California was 100 pairs, but by 1970, this population has declined to 10 birds, of which 2 pairs produced 4 young. In 1975, encouragingly,

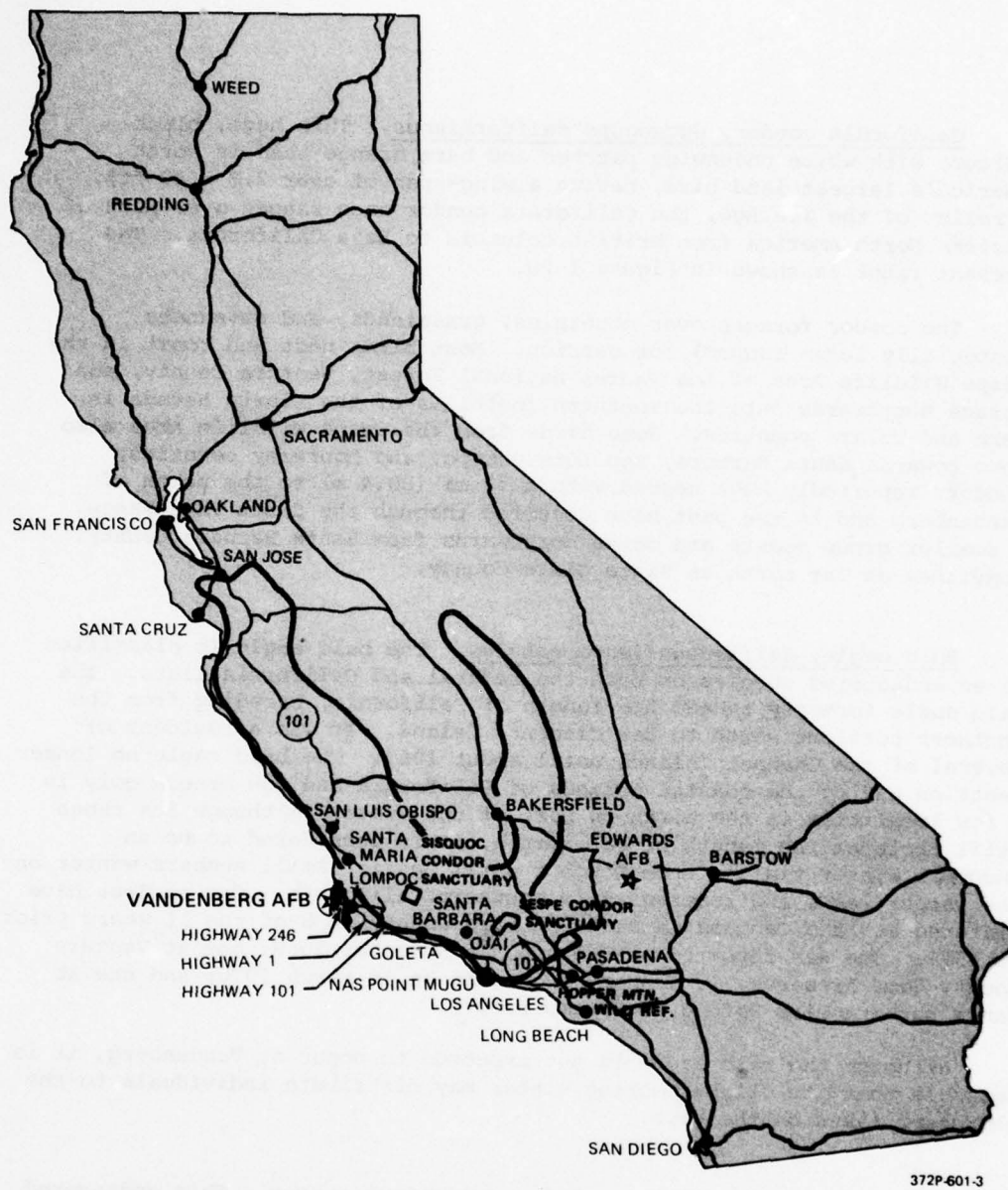


Figure 1-28. California condor range.

8 pairs were found, 6 of which fledged 14 young. The abrupt decline in numbers after the 1940s has been attributed to several factors, including food chain contamination by persistent pesticides and other contaminants, illegal taking and nest robbing by falconers, human disturbance, and occasional shooting.

Although not recently seen, the likelihood of occurrence on Vandenberg is quite good for it feeds mainly along the coastline of the state. In addition to the known nesting on Morro Rock, there is a possibility of other breeding pairs in the area. Either dispersal of fledglings or adults on long-ranging flights during the nonbreeding season could render this as an expected species to occur at Vandenberg at least for feeding and possibly roosting.

Brown pelican, *Pelecanus occidentalis californicus*. This subspecies occurs on the Pacific Coast from Canada to Mexico. Formerly, it was a common resident, but its numbers have decreased. It also occurs as a postbreeding or fall visitor from Mexico. It nests on the Channel Islands, on the coastal islands off of Baja California, and in the Gulf of California. The species is classified as endangered because of drastic reproductive failures due to the collapse of thin-shelled eggs during incubation. This condition has been attributed to the effects of pollutants, particularly chlorinated hydrocarbons, on breeding birds. In 1971, only 7 young were produced in 600 nesting attempts. Encouragingly, reproduction in 1974 and 1975 was 305 and 256 young, respectively. A portion of the Anacapa Island colony nested on an islet adjacent to Santa Cruz Island in 1972, 1974, and 1975. This is the nearest known nesting site to Vandenberg. It is commonly observed flying or feeding in the surf zone on the central California coast. The rocky shoreline and kelp beds of the coast provide excellent roosting and feeding areas for this species. In particular, the area from Point Pedernales to the Boathouse has the highest concentration of pelicans on south Vandenberg.

California least tern, *Sterna albifrons browni*. Formerly an abundant breeding bird in California, it is now classified as endangered because continuing destruction of its few remaining nesting sites, human disturbance, and animal predation are threatening it with extinction.

The least tern is a migratory species. Its wintering area is not known, but may include coastal areas of Central or South America. From April to September, it occurs along the Pacific Coast from San Francisco Bay to central Baja California. Breeding colonies are distributed discontinuously along the coast. About 25 colonies have nested in recent years in California, but in 1977, 29 colony sites were located. The statewide breeding population of least terns was estimated at 624 pairs in 1973; 582 pairs in 1974; 600 pairs in 1975; 664 pairs in 1976; and 775 nesting pairs in 1977.

One of the colonies found and censused for the first time in 1977 was discovered on 10 June 1977, approximately 0.4 mi (0.6 km) south of the Santa Maria River mouth in extreme northern Santa Barbara County. Nests were scattered over an extensive area (approximately 200 acres, or 80 ha) of relatively flat sand dunes 50 to 100 yd (45 to 90 m) east of the beach's high tide line. Hummocks of stabilized sand, ranging from 2 to 6 ft (0.6 to 1.8 m) high, are scattered throughout the area; vegetation promoting formation of these hummocks includes *Abronia latifolia*, *Franseria chamissonis*, *Cakile edentula*, and very limited amounts of *Mesembryanthemum* sp. Ecologically, this is considered one of the most "natural" least tern nesting habitats. This type of habitat exists on Vandenberg and the possibility exists that small or moderate sized colonies remain undiscovered along this stretch of the coastline.

On 8 August 1977, a total of 10 birds, including 6 fledglings, were present at the Santa Ynez River mouth. Earlier (1975) records show 25 least terns at San Antonio Lagoon and at the mouth of the San Antonio Creek. It is possible that these birds had dispersed from the nesting site near the Santa Maria River or had come from some undiscovered site elsewhere along the intervening coastline. The California Least Tern Recovery Team has recommended that:

. . . in light of several proposed projects which would have major environmental impacts along this stretch of coastline [LNG Terminal in the Point Conception area and large-scale space programs based at Vandenberg Air Force Base], . . . major efforts will be made to better define the status of least terns in northern Santa Barbara County and southern San Luis Obispo County.

These intensified search efforts have recently revealed two nesting colonies totaling 15 pairs near the mouth of San Antonio Creek (California Department of Fish and Game, 30 June 1978).

Light-footed clapper rail, *Rallus longirostris levipes*. The light-footed clapper rail is the only clapper rail found in southern California coastal marshes. The total population in California in 1975 was estimated at 250 birds. It ranges from Goleta Slough, Santa Barbara County, south to San Quintin Bay, Baja.

Since the northern limit of the light-footed clapper rail is designated as Goleta Slough, the activities proposed at Vandenberg would not affect this endangered species.

Belding's savannah sparrow, *Passerculus sandwichensis beldingi*. This species is classified as endangered by the California Fish and Game Commission because certain planned developments of southern California

coastal marshes threaten its survival. This subspecies is a resident of tidal estuaries of southern California and Baja. It is closely associated with the pickleweed (*Salicornia*) habitat subject to tidal influence. Surveys in 1973 revealed that only 11 breeding sites exist from Goleta Slough in Santa Barbara County to Imperial Beach, San Diego County.

The exact northernmost range of this subspecies is not known. Several individuals have been observed in the Santa Ynez salt marsh. The northern subspecies, *P. sandwichensis bryanti*, is known only as far south as Morro Bay. This leaves a void in known distribution, and it is quite possible that either or both subspecies may exist in the salt marshes of Vandenberg.

Yellow-billed cuckoo, *Coccyzus americanus occidentalis*. This species, classified by the state as rare, is highly transitory and has never been very numerous in California. Its habitat of dense streamside plant growth has been destroyed by the accelerated land and water use changes which have occurred throughout most of the state. Twenty-five acres (10 ha) of suitable riparian vegetation are required to support one pair.

Several sightings have been reported in the Santa Barbara area, and because of the presence of suitable habitat, it is also likely to occur on Vandenberg. The areas around the riparian habitats at Santa Ynez River, Barka Slough, and San Antonio Creek are adequate at least for resting areas on the migration pattern. These cuckoos arrive in late May and depart in September.

California black rail, *Laterallus jamaicensis coturniculus*. This species is classified as rare by the California Fish and Game Commission. Historically, it occurred in limited numbers in salt marshes from Tomales Bay south to Baja. Nesting in recent years has been reported in inland freshwater marshes along the Colorado River and the Coachella canal. Black rails winter in salt marshes bordering San Francisco Bay. Because of its secretiveness and small numbers, it is rarely seen, and its current distribution and numbers are as yet undetermined. The Fish and Game Department believes that destruction of coastal and inland wetlands by filling and draining threatens habitat vital to the black rail's existence. Its occurrence on salt marshes in the Vandenberg area has not been determined.

White-tailed kite, *Elanus leucurus*. This species is fully protected under the California Fish and Game Code. At one time earlier in this century, this bird was considered as an endangered species in California and its rapid demise was predicted, especially in view of its shy habits and the anticipated urban and agricultural growth of the state. Yet, despite these apparent handicaps, this species has made a remarkable recovery in recent years. The primary food of the white-tailed kite is the vole (*Microtus californicus*). Maintenance of the prey species habitat

is a desirable management practice for this kite. Several nests of this species have been observed in the Barka Slough area, and foraging individuals of the species are commonly observed over annual grasslands on Vandenberg and its environs.

Golden eagle, *Aquila chrysaetos*. This fully protected eagle is a resident species which ranges the entire length of the state. Its habitat is open rolling country of light woodlands and savannahs, grasslands, and farms and ranches. It nests in suitable trees or cliff sites. Although no nests have been reported on Vandenberg, this eagle would be expected to occasionally forage in the area.

Amphibians and Reptiles. Two species of amphibians occurring or expected to occur at Vandenberg are fully protected by California law, and there are five amphibians and six reptiles regulated (i.e., by bag or possession limits) under the California Fish and Game Code.

The southwestern toad (*Bufo microscaphus*) and the red-legged frog (*Rana aurora*) are the fully protected species. The red-legged frog has been observed at Vandenberg where it is confined to permanent bodies of quiet water, such as ponds, pools, and marshes of the San Antonio, Santa Ynez, and Honda drainages. The regulated species of amphibians (bag and possession limit two) are the California tiger salamander (*Ambystoma tigrinum*); the California newt (*Taricha torosa*); the California treefrog (*Hyla regilla*); the foothill yellow-legged frog (*Rana boylei*); and the bullfrog (*Rana catesbeiana*). The regulated species of reptiles at Vandenberg are the western pond turtle (*Clemmys marmorata*); the horned lizard (*Phrynosoma coronatum*); the California legless lizard (*Anniella pulchra*); the California mountain kingsnake (*Lampropeltis zonata*); the common kingsnake (*Lampropeltis getulus*); and the two-striped aquatic garter snake (*Thamnophis elegans*).

Mammals. No species of terrestrial mammals on the federal or California endangered lists are known to occur on Vandenberg.

The ring-tailed cat (*Bassariscus astutus*) and the mountain lion (*Felis concolor*) are fully protected under the California Fish and Game Code. Both species are suspected to occur on Vandenberg.

Insects. There are six California butterflies on the federal endangered list, but none of their ranges impinge on Vandenberg.

Terrestrial Vegetation (1.2.2.2.2). Vandenberg is situated in an area of marked transition between northern and southern California cismontane vegetation, and is, for this reason, of great biogeographic interest. Many

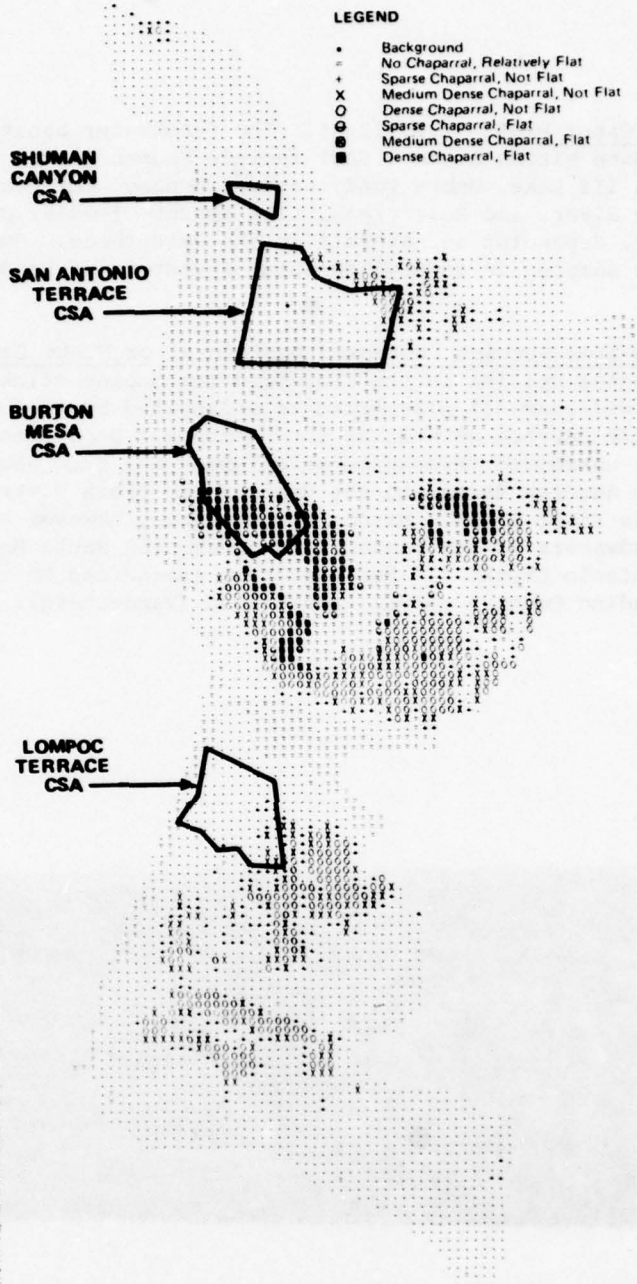
plant species of northern California reach their southern limits on or in the vicinity of Vandenberg, and, similarly, the distribution of many southern California species ends here (Smith, 1977; Coulombe and Mahrtdt, 1976). Intermittent rows of introduced Eucalyptus windbreaks were planted to support agricultural activities prior to the establishment of Camp Cooke.

There are several communities of particular biological interest on base. Some of these are indicated in Figure 1-29. Bishop pine and tanbark oak forests, relictual patches of northern California vegetation, occur in areas having better moisture and depend at least partially on fog-drip as a moisture input. The chaparral of the wind-swept coastal mesas, as on Burton Mesa, is unusual for its extremely low stature and for the species present. Figure 1-30 indicates the distribution of chaparral on different terrain types on base, and includes this unusual type (outlined). Several of the dominant plants in this vegetation are localized to a small area centered in Santa Barbara and San Luis Obispo counties. The coastal sand dunes are well-developed and are extensive in the northern part of Vandenberg. Of these special-interest communities, the coastal sand dunes and chaparral are the only ones likely to be directly affected by proposed MX activities.

Currently, no plant species on Vandenberg is protected by federal or state endangered or threatened species legislation. At the federal level, the Endangered Species Act of 1973 applies to those plant species written into its protection, a category at present embracing only four plant species, all restricted to San Clemente Island with an additional thirteen species, none of which occurs on Vandenberg, awaiting final rulemaking. Species are included under the protection of this law as sufficient information to ascertain their status and determine the nature and magnitude of the threat to their existence becomes available.

Species listed in "Proposed Endangered Status for 1,700 U.S. Vascular Plant Taxa" (*Federal Register*, 16 June 1976) can be given protection by final rulemaking of the U.S. Fish and Wildlife Service upon short notice, and other species, given that a substantial threat to their continued existence can be demonstrated, could also be included by final rulemaking under the protection of the law, in a minimum time of about 120 days.

The plants considered in the Candidate Siting Area investigation are those species known from Vandenberg and listed in "Proposed Endangered Status for 1,700 U.S. Vascular Plant Taxa" (*Federal Register*, 16 June 1976), in the list of threatened and endangered plant species prepared by the Smithsonian Institution and published for review in the *Federal Register* (1 July 1975), and those species listed in the California Native Plant Society's "Inventory of the Rare and Endangered Plants of California" (Powell, 1974). Species on either of the federal lists will be referred to as "candidate threatened or endangered plant species;" species on the California list will be referred to as "special interest" species. A listing of the candidate threatened and endangered species that may be found on the candidate sites at Vandenberg is included in Appendix C.

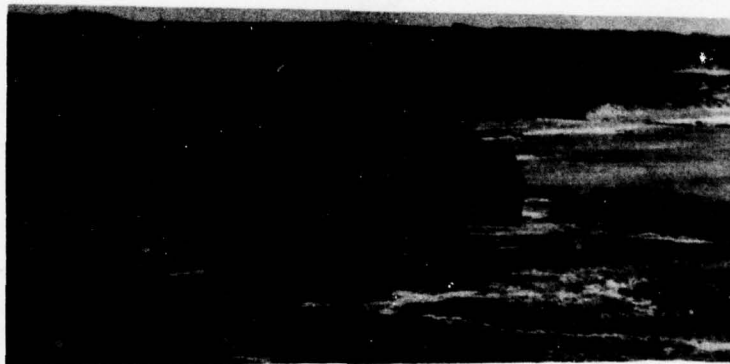


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Figure 1-30. Distribution of chaparral on different terrain types on VAFB. Produced from VAFB Environmental Planning System Data Base (Reilly et al., 1976).

Freshwater Biota (1.2.2.2.3). The freshwater habitats on or near the candidate siting areas (CSAs) include Shuman Canyon Creek, San Antonio Creek, Mod III Lake, Umbra Pond, several unnamed marshes and ponds, the Santa Ynez River, and Bear Creek. The amount of water present varies seasonally, depending on rainfall in the watersheds. Several of these areas were sampled in an environmental inventory of Vandenberg.

Freshwater Species Protected by Federal or State Law. The only protected freshwater species is the unarmored threespine stickleback (*Gasterosteus aculeatus williamsoni*) classified as endangered by the United States Fish and Wildlife Service as well as the California Department of Fish and Game. The unarmored threespine stickleback was once abundant in streams of the Los Angeles Basin, in the upper Santa Clara River, and in the Santa Maria River Basin. Natural populations, however are now restricted to the headwaters of the Santa Clara River, the Santa Maria River Basin, and San Antonio Creek. It has also been introduced in the Mojave River (San Bernadino County) and El Rancho Pond (Vandenberg).



The preserved coastal areas of Vandenberg AFB provide shelter for large herds of deer, feral pig, and an occasional mountain lion. Area specific Lompoc Valley vegetation and undisturbed Chumash sites are found in many areas of the base. The photograph above is south-east toward Shuman Canyon. Minuteman facilities can be seen on the bluff at the left of the photograph.

Marine Biota (1.2.2.2.4). Marine habitats in the vicinity of the candidate siting areas are the Pacific Ocean and coastal lagoons of rivers and creeks. The ecology and biota of these habitats are discussed in the Ecological Assessment of Vandenberg (Coulombe and Cooper, 1976; Coulombe and Mahrtdt, 1976). No impacts to the coastal marine environment from the MX test programs are expected; thus, only the marine mammals utilizing the shore and those species protected by law will be discussed here. The marine mammals that frequent the beach areas include California sea lions (*Zalophus californianus*) and harbor seals (*Phoca vitulina*) with the latter reported to breed in rocky areas on Vandenberg (SAMSO, 1978).

The leatherneck turtle (*Dermochelys coriacea*) is the only marine reptile on the federal endangered species list which could occur in the vicinity of Vandenberg. The subspecies *schlegeli* is found along the west coast of North America, ranging as far north as Vancouver Island, British Columbia. It also ranges considerable distances offshore.

Most of the whales that pass by the area are on the federal endangered species list. The California gray whale (*Eschrichtius gibbosus*) is probably the most conspicuous species. In late fall, California gray whales migrate along the coast from the Bering and Chukchi Seas to their winter spawning areas along the coast of Baja California. The return migration is in late winter with females and young farther offshore (Bureau of Land Management (BLM), 1975).

California sea lions (*Zalophus californianus*) breed on Seal Rock at Point Sal Beach and frequently come ashore along Vandenberg's protected beaches.



Vandenberg is within the former breeding range of southern sea otters (*Enhydra lutris*) and Guadalupe fur seals (*Arctocephalus phillipi townsendi*) although none are known to breed there at present. The Guadalupe fur seal is classified as rare and is fully protected by the California Department of Fish and Game. This seal occurred historically from the Farallon Islands west of San Francisco, south to San Benito Island, Baja California. Human disturbance and illegal shooting are responsible for the slowness of the recovery of this species. A breeding colony on Guadalupe Island off Baja is fully protected by the Mexican government and is slowly increasing in numbers, although permits are issued occasionally for zoo collections. This seal has been seen in recent years at San Miguel Island but is not normally expected along the coast of Santa Barbara County.

The southern sea otter is also fully protected by the California Department of Fish and Game. It formerly inhabited the coast of southern California to Baja California and was extirpated by hunters in the early 19th century. This species is recovering and has extended its range from Monterey to Morro Bay, approximately 40 mi (64 km) north of Vandenberg. Further reestablishment is possible in areas with undisturbed habitat (BLM, 1975).

Socioeconomic Environment of Vandenberg and Its Environs (1.2.2.3).

The objective in presenting a discussion of the existing socioeconomic environment is to develop a base of historical facts, present patterns and problems, and projected futures which are the essential backdrop against which to assess the project effects and, thus, determine impacts.

Employment in Santa Barbara County (1.2.2.3.1). The Santa Barbara County Planning Department recently estimated the 1 April 1977 population to be 282,906, a gain over the 1975 special census total of 280,605. The following is a list of selected economic data for Santa Barbara County.

• civilian labor force, February 1978	134,500
• total employment (place of residence), February 1978	124,700
• total unemployment, February 1978	9,800
• unemployment rate	7.3%
• total taxable sales, 1976	967,683,000
• total personal income, 1975	\$ 1,771,843,000
• UCSB employment, 1977	5,504
• VAFB work force, 1977	10,238
• 1976 tourism estimate, 1976	4,000

In economic terms, the driving forces are termed basic or export industries in that they provide jobs and income themselves, and, since they represent demands for the region's goods and services from outside the region, they bring in "new money" which fosters growth in local or nonbasic industries as well. Activities at Vandenberg produce added employment and earnings. Table 1-16 presents regional employment by industry for February 1978.

Table 1-16. Regional employment of wage and salary workers (place of work) by industry, February 1978.

INDUSTRIAL DIVISION	EMPLOYMENT	PERCENT OF TOTAL
Agriculture	6,200	5.6
Mining	1,000	0.9
Construction	4,100	3.7
Manufacturing	13,100	11.8
Nondurables	3,200	2.9
Durables	9,900	8.9
Aerospace Related	6,600	5.9
Transportation, Communication, and Public Utilities	3,800	3.4
Wholesale Trade	3,400	3.1
Retail Trade	22,000	19.8
Finances, Insurance, and Real Estate	4,500	4.1
Services	26,500	23.9
Government	26,100	23.5
Federal	3,600	3.2
State and Local	22,500	20.3
Total	111,000	99.8

372T-3016

Source: Employment Development Division, 1978.

The three leading sources of basic employment are presented: Vandenberg AFB, UCSB, and tourism. UCSB and tourism relate primarily to the South Coast. Vandenberg AFB is the dominant employer in North County.

Vandenberg Employment. Vandenberg is the major civilian employer in the north of Santa Barbara County, and, including military personnel, it is the largest employer in Santa Barbara County. As such, employment at the base (military, civil service and contractor) has long been a dominant factor in the economic health and development of the North County with lesser but still important effects on the South Coast. Growth in base work force from 1960 to 1977 has been:

1960	12,519	1969	16,039
1961	15,879	1970	13,568
1962	20,485	1971	12,035
1963	20,554	1972	12,442
1964	20,406	1973	11,564
1965	17,292	1974	10,182
1966	18,517	1975	10,313
1967	19,132	1976	10,568
1968	17,689	1977	10,238

- Growth in the early sixties was impressive, peaking in 1963 and 1964, and the impact on other employment areas and on population in the North County was large.
- By the mid-sixties a general pattern of downward trend is visible from 1963's 20,554 to 1975's employment of 10,313. Base work force size has been essentially level for 1975 through 1977.
- In earlier planning for the establishment of the Space Shuttle program at Vandenberg, it was generally thought that, aside from the bulge of the construction work force and some of the installation and checkout (activation) personnel, the base work force would show little if any change, assuming that transfers from the expendable launch vehicle programs would handle the Space Shuttle work.
- The employment pattern presently shows a recent leveling and forms part of the baseline information necessary to better visualize impacts in an historical context.

Summary of Regional Employment Features

- Vandenberg is the largest employer in the region and the North County in particular is sensitive to changes at Vandenberg.
- The North County has weathered the decline in the base working force without sharing that decline, although the downward trend prevented growth which would have occurred otherwise.
- Agriculture and mining are not growth areas in employment terms and both are primarily basic industries.



Santa Barbara's climate, beaches, boats and picturesque beauty with tree lined streets and Moroccan architecture has continued to lure those tourists seeking a restful environment. Tourism with 4,000 employees, is the third largest employer in the county, behind Vandenberg (10,238) and the University of California (5,504).



- Manufacturing has grown, especially in aerospace related areas of work.
- The high growth areas of services and retail trade hold promise for further growth, with tourism, sales to students and Vandenberg personnel. The generally low wage nature of the businesses will continue and perhaps expand the low income part of the residents and related socioeconomic difficulties.
- The anticipated leveling off of employment at UCSB will stop that source of growth in the South Coast.

Employment in the Base Environs. The communities surrounding Vandenberg are most sensitive to the rise and decline of the many missile and space programs there which condition the size of the base working population. Growth in the Vandenberg environs has been very strongly influenced by Vandenberg in at least three important respects:

- The base itself is a major employer and large fractions of the base labor force live in the Lompoc and Santa Maria valleys.
- The base local procurement is, in part, from businesses in these communities, and provides employment for local residents.
- Family members of personnel living on base find employment in the local area to augment family earnings.

The Importance of Vandenberg in North County Employment. Three points reflect the importance of Vandenberg in the North County economy:

- Of the 10,182 base working population in 1974, 31.7 percent lived on the base, 40.1 percent lived in the Lompoc area and 23 percent lived in the Santa Maria-Orcutt area. These residential locations covered 94.8 percent of the base work force in 1974.
- Total employment for the base and the environs was 20,495 workers in 1960, 30,707 in 1970, and 33,086 in 1975. At the same time the base working population was 12,519 in 1960, 13,568 in 1970, and 10,313 in 1975.
- Although the base has declined from one-half to approximately one-third of the total work force in the North County, Vandenberg provides a substantial center for overall economic activity.

Summary and Conclusions Regarding Employment on the Base and Its Environs.

- While the base has been a dominant basic source of growth and change in the local environs, the communities' working residents have found jobs permitting some growth in the face of declining jobs on the base.

- The degree of sensitivity to change on the base cannot be ascertained with real accuracy since the data relate to place of residence and not to place of work, but general conclusions are possible.
- In general, when the base grows, indirect jobs are generated in the local area and these contribute strongly to growth. This source disappears with declines in base expenditures.
- In general, the local environs are still sensitive to changes on the base, although much less so than in the early years of base activity.

Income Distribution (1.2.2.3.2). In 1974 the median household income for the county was \$11,017. Seven of the eleven planning areas showed median incomes higher than the county median. The Montecito Planning Area had the highest median income of \$21,071, followed by the Vandenberg area (excluding VAFB) with \$16,167, the Orcutt area with \$15,145, and the Goleta area with \$12,682. The two largest cities of Santa Barbara and Santa Maria, with median household incomes of \$8,854 and \$10,814, respectively, were below the county median, as were the two mainly rural areas of Guadalupe and Cuyama Valley. Payroll by industry for the North County and South Coast is given in Table 1-17.

Table 1-17. Payroll by industry in the North County, the South Coast, and the total county, 1971 (\$ thousands).

INDUSTRIAL DIVISION	NORTH COUNTY PAYROLL	SOUTH COAST PAYROLL	TOTAL COUNTY	NORTH COUNTY (PERCENT)
Agriculture	14,311	7,830	22,141	64.6
Mining	5,785	3,316	9,101	63.6
Construction	14,502	23,946	38,448	37.7
Manufacturing	47,695	34,755	82,450	57.8
Transportation, Communication, and Public Utilities	9,216	15,175	24,391	37.8
Wholesale Trade	6,721	17,761	24,482	27.5
Retail Trade	30,336	41,944	72,280	42.0
Finance, Insurance, and Real Estate	5,732	17,115	22,847	25.1
Services	39,293	101,298	140,591	27.9
Other	8,000	16,600	24,600	32.5
Government				
Federal-Defense	16,600	—	16,600	100.0
Federal-Nondefense	7,293	11,466	18,699	38.7
State	23,894	61,139	85,033	28.1
Special District	1,700	2,550	4,250	40.0
County	3,670	20,790	24,460	15.0
City	8,000	7,360	15,360	52.1
Total	242,688	383,045	625,733	41.9

3727-3017

Source: Dodson, Eisenhut, and Yates, 1972.

Housing (1.2.2.3.3). The availability of temporary and permanent housing is an important element in estimating impacts associated with new employment opportunities.

An overall picture of the distribution of housing stock and vacancy rates in Santa Barbara County, including mobile homes, is provided in Table 1-18. Countywide, approximately 102,000 units existed in 1975 and the overall vacancy rate was estimated at 3.6 percent. Some local observers believe that 2 to 3 percent is a more accurate estimate, while an August 1976 HUD survey of Santa Barbara and Santa Maria revealed a vacancy rate of 1 percent.

The North County/South Coast housing split is shown in Table 1-19. There were approximately 36,261 dwelling units of all types in the North County in 1975. About 72 percent of these units were single-family homes. The total number of South Coast housing units in that year stood at about 65,667. Of these, 54.7 percent were single-family homes.

As shown on summary Table 1-20, Mission Hills and Orcutt show typical characteristics of suburbs with at least 80 percent of homes being single-family. The incorporated places, Lompoc and Santa Maria, have both single- and multi-family units. Vacancy rates for dwellings in Santa Maria and Lompoc showed similar trends with both communities having higher vacancy rates for multiple-family units than

Table 1-18. Housing stock and vacancy rates in Santa Barbara County, 1975.

UNIT TYPE	HOUSING UNITS ¹	AVAILABLE VACANT UNITS	VACANCY RATE (PERCENT)
Single Family	62,135	1,334	2.1
Duplex-Fourplex	11,555	406	3.5
Multifamily	21,664	1,479	6.8
Mobile Homes	5,618	293	5.2
Miscellaneous	956	109	11.4
Total All Types	101,928	3,621	3.6

¹Excludes Vandenberg Air Force Base.

372T-3018

Source: State of California, Department of Finance, 1976.

Table 1-19. Mix of units between the North County and the South Coast of Santa Barbara County, 1975.

AREA		TOTAL POPULATION	TOTAL ALL UNITS	SINGLE-FAMILY UNITS	MULTIFAMILY UNITS	MOBILE HOMES	MISCELLANEOUS
North County	Number	114,295	36,261	26,210	7,028	2,786	237
	Percent	41	36	42	21	50	25
South Coast	Number	166,310	65,667	35,925	26,191	2,832	719
	Percent	59	64	58	79	50	75
County Total ¹	Number	280,605	101,928	62,135	33,219	5,618	956
	Percent	100	100	100	100	100	100

¹Data include vacant units, but not Vandenberg AFB.

372T 3019

Source: Santa Barbara County-Cities Area Planning Council, 1977.

Table 1-20. Summary of housing units and vacancy rates in selected areas in the North County, 1975.¹

DWELLING TYPE	LOMPOC	VANDENBERG VILLAGE	MISSION HILLS	SANTA MARIA	ORCUTT
Single Family					
Number	5,007.0	1,034.0	760.0	8,291.0	5,410.0
Percent of Total	59.2	79.8	99.9	67.6	89.9
Vacant	146.0	25.0	28.0	263.0	142.0
Percent Vacant	2.9	2.4	3.7	3.2	2.6
Multifamily					
Number	2,869.0	260.0	0.0	3,070.0	99.0
Percent of Total	33.9	20.1	0.0	25.0	1.6
Vacant	200.0	26.0	0.0	168.0	32.0
Percent Vacant	6.9	10.0	0.0	5.5	3.2
Mobile Homes/Trailers					
Number	582.0	2.0	1.0	765.0	509.0
Percent of Total	6.9	0.1	0.1	6.2	8.5
Vacant	37.0	0.0	0.0	46.0	16.0
Percent Vacant	6.3	0.0	0.0	6.0	3.1
Total Units					
Number	8,458.0	1,296.0	761.0	12,266.0	6,018.0
Percent of Total	100.0	100.0	100.0	100.0	100.0
Vacant	383.0	51.0	28.0	477.0	190.0
Percent Vacant	4.5	3.9	3.7	3.9	3.2

Source: State of California, Department of Finance, 1976.

372T 3020

¹Additional North County areas not included in this table are the Santa Ynez Valley, Guadalupe, and New Cayama.

for single-family units. Vandenberg Village has a concentration of single-family homes but also some multi-family units, most of which are condominiums. In 1975, Vandenberg Village had the highest multi-family vacancy rate noted, 10 percent. Price differentials in rental housing between the Lompoc and Santa Maria Valleys as well as increased employment at VAFB have currently reduced the Vandenberg Village vacancy rate to the Lompoc-Santa Maria level.

Housing Costs. In October 1976, the average home sales' price in the South Coast was \$63,947. In November 1976, 17 homes in the Santa Maria area sold for a median price of \$41,169. While sample size was quite small, the Southern California Residential Research Council found that prices of existing houses had appreciated 39 percent in Santa Barbara (South Coast), and by 48 percent in Santa Maria-Lompoc. This suggests that while South Coast housing is, in general, substantially higher than in the North County, the gap may be closing, although data—particularly for the North County—are too sparse to be sure of such a trend. In the third quarter of 1976, the average price of new single-family homes in the city of Santa Barbara was in the \$100,000 to \$110,000 bracket (APC, May 1977 and June 1977).

Rental Costs. While rents have not had the spectacular rise exhibited by home purchase costs in recent years, "low" rent is quite rare as shown in Table 1-21. Rents vary substantially by area within the county, but as in the case of home prices, the rental ranges in Santa Maria and Lompoc tend to be lower than those for all of the South Coast communities.

Many older residences on tree-lined Lompoc streets and in Santa Maria were constructed decades before the boom of housing tracts around 1960.



Table 1-21. Range of rent by number of bedrooms for selected areas, Santa Barbara County, 1976 to 1977.

NUMBER OF BEDROOMS	CITY OF SANTA BARBARA	GOLETA	SANTA MARIA	LOMPOC
Studio	\$125 to 200	\$150 to 209	—	—
1	\$170 to 250	\$206 to 260	\$150 to 195	\$125 to 180
2	\$190 to 300	\$226 to 284	\$150 to 300	\$140 to 265
3	\$290 to 550+	\$260	\$225 to 300	\$165 to 210
4	\$325 and up	\$260	—	—
Sample Size	N.A. ¹	68	N.A. ¹	N.A. ¹

372T-3021

¹Not available.

Source: Santa Barbara County-Cities Area Planning Council, 1977.

Recent Housing Activity. Within the residential construction sector, multiple-unit construction suffered the greatest decline from 1973 into the 1974-1975 recession. Figure 1-31 shows the sharp drop, countywide, from 2,568 multiple-family authorized units in 1973, to 861 in 1974, and 341 in 1975. Of total dwelling units authorized, the number authorized had dropped by 1975 to about one-third of the 1973 level, but with a substantial recovery to 1,930 units, in 1976. Most of the



Vandenberg Village is chiefly a single-family residential area although there are approximately 100 condominium units including those pictured.

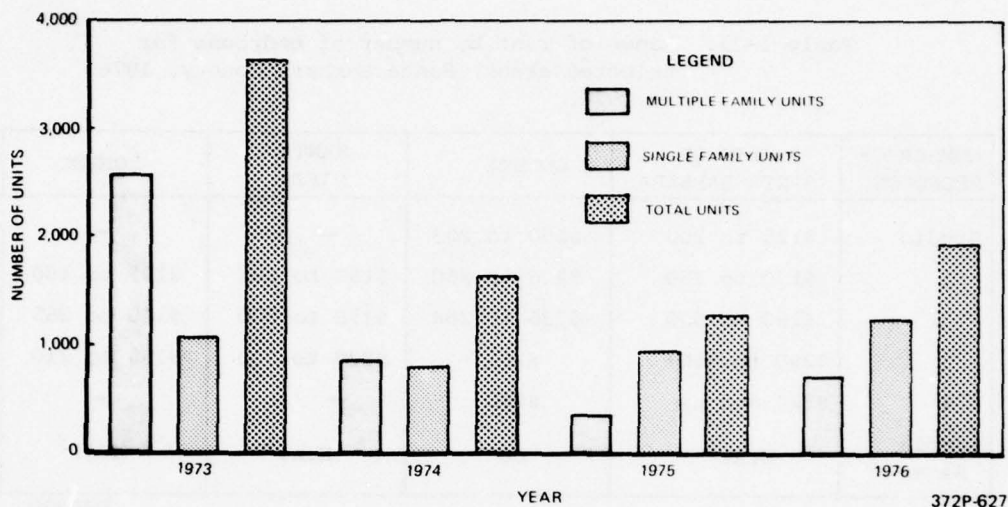


Figure 1-31. Residential units authorized for construction in Santa Barbara County.

recovery has been for single-family housing where 1976 permits exceeded the 1973 levels. Multiple-family units have shown a strong 1-year recovery (1975 to 1976), but do not approach 1973 levels. Multiple-family housing, in particular, is strongly affected by growth controls on the South Coast. Trends within the county are mixed. Lompoc and Santa Maria were notable for their consistent rise, while Carpinteria and Santa Barbara were falling. This upward thrust of Lompoc and Santa Maria appears in additions, alternations, and repairs data also.

Transportation (1.2.2.3.4). Flow conditions on the major sections of the road network are categorized by peak hour level of service as follows:

- A - Free Flowing
- B - Free Flowing Restricted
- C - Desirable Design Capacity
- D - Acceptable Design Capacity In Extensive Circumstances
- E - Maximum Capacity with Considerable Congestion
- F - Total Congestion

Those roads which serve the base are presently at Level of Service C or better, except for a limited number of locations. The various locations where congestion now frequently occurs are shown on Figure 1-32A.

The portion of the State Route 1, H Street, which traverses the downtown section of the city of Lompoc, frequently operates at Level D during the daily periods of peak flow. This segment of road has four operating lanes, is signalized and carries in excess of 2,500 vehicles per hour in the hours of peak flow.

Route 246 between Buellton and Solvang frequently becomes congested at this time. This is a two-lane roadway which carries approximately 1,350 vehicles per hour in both directions combined. The capacity at Level of Service C is approximately 1,150 vehicles per hour.

The two-lane section of Route 246 west of Buellton also experiences some peak hour congestion since daily peak hour volumes are approximately 1,100 and the capacity at Level of Service C is about 900 per hour.

Congestion also occurs along State Route 1 north of Mission Hills. Although the normal traffic volumes on this road segment are light, the alignment and grades are very poor and its capacity is limited to approximately 320 vehicles per hour for Level of Service C.

Access to the main gate of the base is provided by County Highway S20 (Lompoc-Casmalia Road). As shown in Table 1-22, approximately half of the vehicles entering the base use other gates around the base perimeter. That portion of the work force (approximately 25 percent) who live onbase, are in car pools, or use public transportation to reach work are not included in the table, as it reflects vehicles rather than individuals (Vandenberg AFB, 1974).

To minimize congestion at the various gates, work starting times have been staggered by 15-minute intervals to spread the peak traffic load. This operational measure has lessened the peak volume appreciably from previous totals. As is apparent from Table 1-22, congestion at the Pine Canyon and Main Gates could be further relieved by the shifting of additional vehicles from the 0730 time period to earlier arrivals.

Near-Term Traffic Growth. Existing records of traffic volumes for several previous years have been used in developing estimates of future traffic growth in the vicinity of Vandenberg. For the most part, the analysis indicates relatively small changes in traffic volumes due to normal causes. The locations of congestion in 1981 without any major new projects are shown on Figure 1-32B. As indicated, there is no appreciable change in severity from that now encountered.

Table 1-22. Morning traffic volume into Vandenberg AFB
(Vandenberg AFB, 1974).

GATE	TIME OF DAY					
	0700	0715	0730	0745	0800	TOTAL
Pine Canyon Gate	160	484	728	618	460	2,450
Main Gate	244	582	1,130	600	900	3,456
Utah Gate	0	8	22	2	6	38
Titan Gate	6	20	196	2	146	370
13th Street Gate	38	158	142	184	130	652
South Gate	20	38	244	160	154	616
Total	468	1,290	2,462	1,566	1,796	7,582

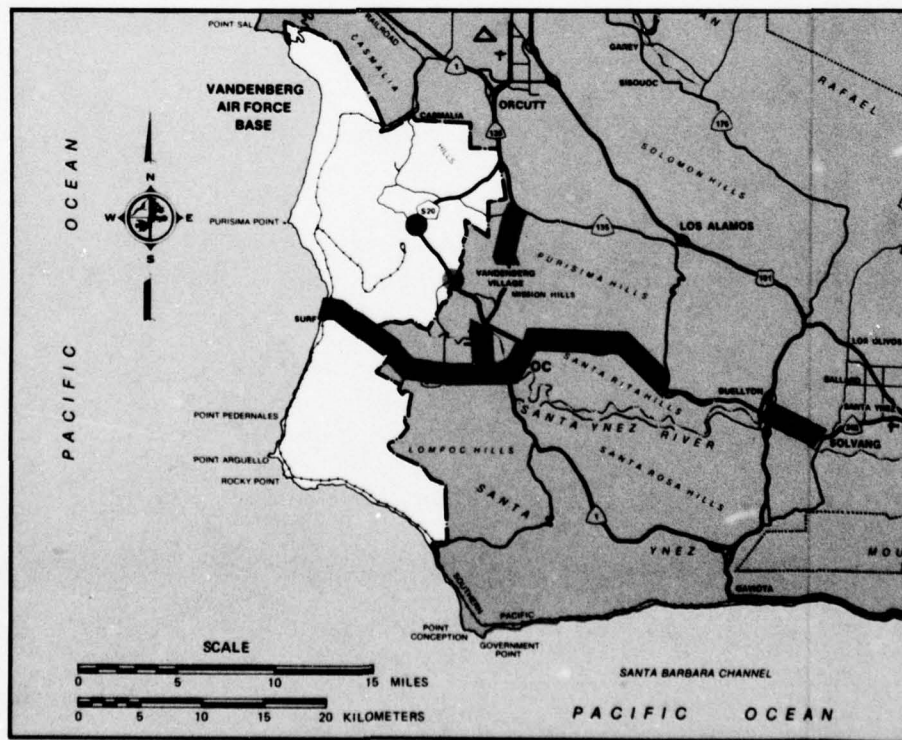
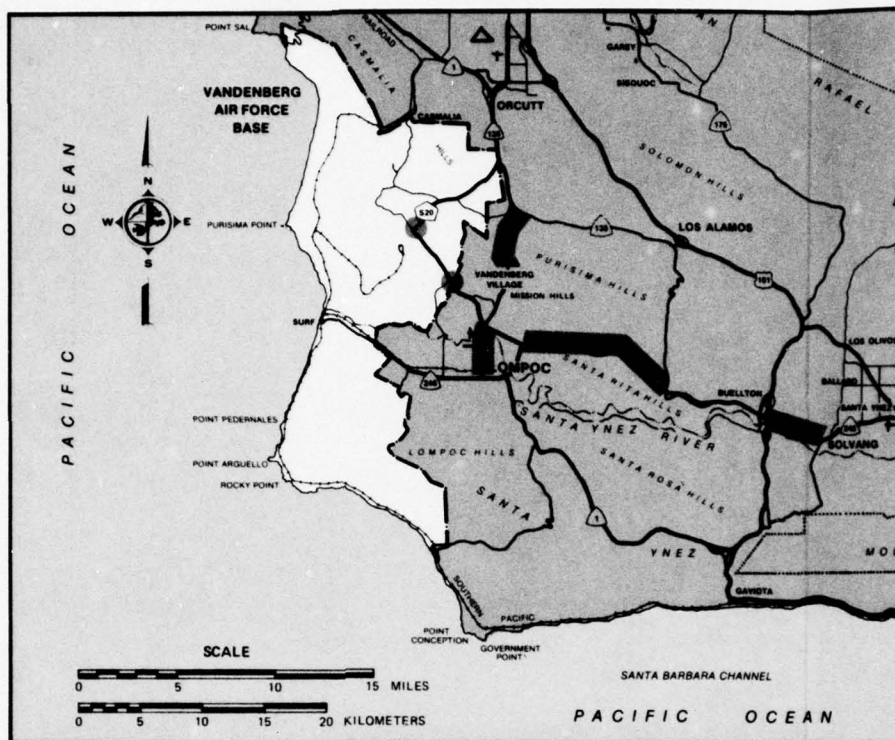
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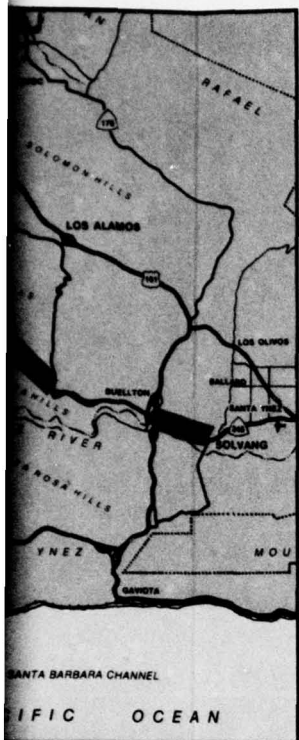
It is presently planned that the Space Shuttle facility will be constructed at Vandenberg within the near future. If that occurs, traffic volumes on the various roads leading to and from the base will be altered appreciably.

Table 1-23 shows the estimated traffic volumes on various road segments on 4-lane highways assuming the Shuttle is under construction in 1981, and Table 1-24 shows the volumes for 2-lane roads. These tables also show various locations where traffic operational difficulties are expected. These locations of anticipated traffic congestion also are shown on Figure 1-32C and are described below.

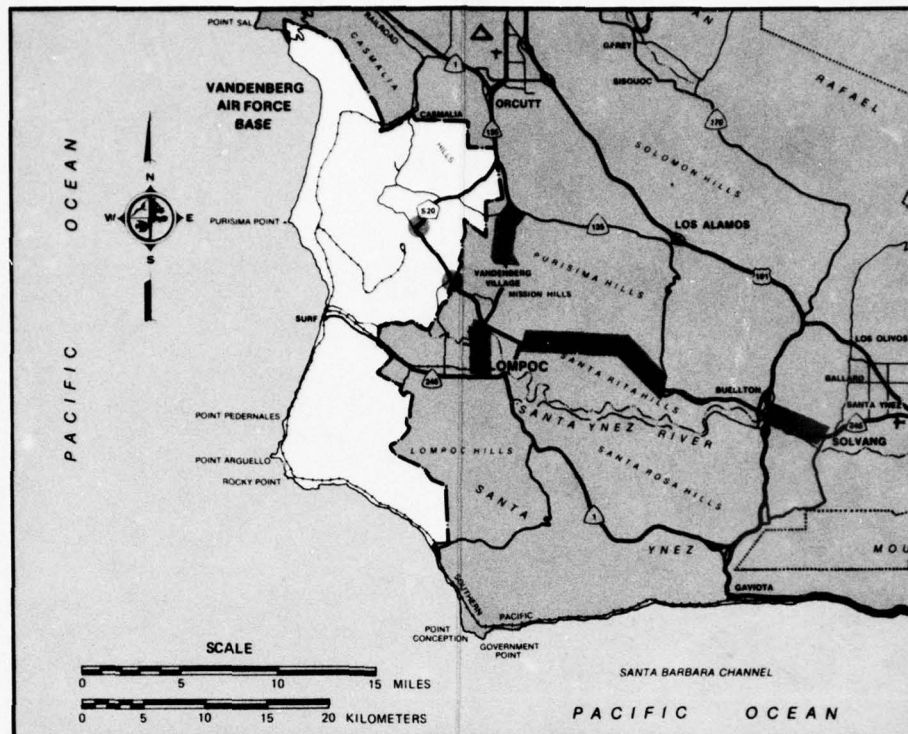
Route 246 West of Lompoc. Route 246 is now only two lanes wide west of Lompoc. If the Shuttle is constructed, relatively heavy congestion along this road segment may occur, although staggering workers' starting times could eliminate some of the problem. Widening this section of roadway to four lanes may be advisable.

Route 246 Within Lompoc. It is anticipated that the Shuttle construction would add approximately 185 vehicles to Route 246 through Lompoc. Although this would only average three vehicles per minute, some congestion may occur. Revised signal timing and related traffic operation improvements can provide adequate travel conditions.





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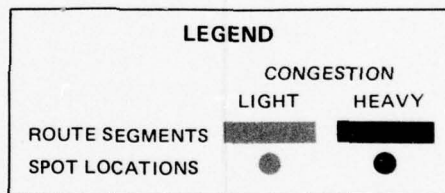


B.

PROJECTED (1981) PEAK HOUR CONGESTION WITHOUT SPACE SHUTTLE OR MX PROJECTS.



WITH SPACE
OUT MX.



372P-888

Figure 1-32. Present and projected peak hour congestion scenarios in the Vandenberg environs.

Missile Flight Testing III-115

Table 1-23. Estimated peak hour traffic volumes on four-lane roads during Space Shuttle construction, 1981.

ROUTE SEGMENT	1981 BASELINE VOLUME	INCREASE DUE TO SHUTTLE CONSTRUCTION	TOTAL	PERCENT INCREASE	ROADWAY CAPACITY	EXCESS OVER CAPACITY	DEGREE OF TRAFFIC CONGESTION	
							LIGHT	HEAVY
Route 101 South of Gaviota Pass	1,630	135	1,765	8	2,310	-		
Route 101 South of Buellton	1,411	-	1,411	-	2,310	-		
Route 101 South of Los Alamos	1,685	1	1,686	-	2,340	-		
Route 1 West of East Junction with Route 246	460	192	652	42	1,420	-		
Route 1 at Santa Ynez River (Lompoc)	1,274	82	1,356	6	2,000	-		
Route 1 North of Vandenberg Road (S20)	1,320	275	1,595	21	1,790	-		
Route 246 West of Route 1 (Lompoc)	960	185	1,145	19	1,180	-		
Route S20 Northwest of Route 1	1,260	124	1,384	10	1,900	-		
Route S20 Southeast of Main Gate	595	92	687	15	1,900	-		
Route S20 Southeast of Main Gate	843	276	1,119	33	1,900	-		
Route S20 Southwest of Route 1	850	275	1,125	32	1,900	-		
Route 135 North of Route 1	874	275	1,149	31	2,240	-		

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Table 1-24. Estimated peak hour traffic volumes on two-lane roads during Space Shuttle construction, 1981.

ROAD SEGMENT	1981 BASELINE VOLUMES	INCREASE DUE TO SHUTTLE CONSTRUCTION	TOTAL	PERCENT INCREASE	ESTIMATED TWO DIRECTION VOLUME	ROADWAY CAPACITY	EXCESS OVER CAPACITY	DEGREE OF TRAFFIC CONGESTION	
								LIGHT	HEAVY
TWO DIRECTION VOLUME									
Route 1 South of Lompoc	211	135	346	64	485	800	113	✓	
Route 1 North of Mission Hills	250	18	268	7	433	320	—		
Route 1 Northwest of Orcutt	114	—	114	—	190	850	—		
Route 246 East of Buellton	830	88	918	11	1,468	1,150	318		✓
Route 246 West of Buellton	605	117	722	19	1,125	800	325		✓
Route 246 West of Lompoc- Casmalia Road	193	57	250	30	377	750	—		
Route 246 West of Lompoc	420	448	868	107	1,148	800	348		✓
Route 135 West of Los Alamos	42	1	43	2	71	800	—		
Lompoc-Casmalia Road Northwest of Main Gate	195	3	198	2	328	700	—		
Lompoc-Casmalia Road South of Casmalia	110	13	123	12	196	650	—		
Lompoc-Casmalia Road Northwest of Route 246 (Lompoc)	180	60	240	33	360	600	—		
San Antonio Road East of Route S20	15	1	16	7	26	400	—		

3/21/2024

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Route 246 Between Lompoc and Buellton. Some congestion now occurs along the two lane portion of Route 246 between Lompoc and Buellton. The Shuttle construction could add 117 vehicles to the peak hour flows on this road segment and congestion could become heavy. Staggering of Shuttle construction worker-start times could alleviate this problem and road widening would not be necessary.

Route 246 Between Buellton and Solvang. This section of roadway now experiences congestion which is gradually increasing due to normal growth. Although the Shuttle construction would only add an estimated 88 vehicles in the peak hours, the congestion could become heavy unless traffic operational improvements are made.

Route 1 (H Street) in Lompoc. Peak hour congestion now occurs along H Street in Lompoc. The Shuttle construction might add 82 vehicles to this flow during the peak. This would be a significant increase.

Route 1 North of Mission Hills. Minor congestion now occurs along the mountainous portion of Route 1 north of Mission Hills. No change is projected in the severity of this congestion.



The Vandenberg Air Force Base main gate is fed directly by the four-lane route S-20 from Santa Maria-Orcutt and the four-lane Lompoc-Casmalia Road segment from Lompoc.

Main Gate Intersection. Some congestion now occurs at the signalized intersection just outside the Main Gate. During construction of the Shuttle, volumes through this intersection are expected to increase approximately 26 percent. This will require a careful and detached study and probably a major redesign of the intersection.

Main Gate Operation. During construction of the Shuttle, peak hour traffic entering the Main Gate is expected to increase by approximately 360 vehicles during the peak period. This increase may require an expansion of the existing gate facilities or additional staggering of work schedules.

Pine Canyon Cutoff. A minor traffic problem now exists at the intersection on S20 where traffic exits to go to the Pine Canyon Gate. A significant increase in this problem due to construction of the Shuttle is not anticipated.

Effect of Shuttle Operations Stage. Upon completion of construction of the Shuttle, the construction workers would be replaced by technical personnel who will operate the facility. It is anticipated that the new Shuttle operational personnel will reside in communities relatively close to the base. This would practically eliminate travel to and from the South Coast area. The anticipated travel patterns of these new workers have been analyzed using the same procedures followed in estimating the travel patterns and effects of the construction workers. Since the total number of new operational personnel will be appreciably less than the number of construction workers, any traffic problems that occur during construction will be reduced during operations.

Rail Transportation. Southern Pacific Railroad lines pass directly between some launch facilities and the ocean, so that the tracks are overflowed on some launches. To minimize the potential risk to people and property, overflights of trains do not occur. This is accomplished through close communication with the stationmaster.

Marine Transportation. Current space and missile operations at Vandenberg require the designation of danger zones. Marine traffic is advised by radio broadcasts, announcements in the Notice to Mariners, current status announcements at local harbors, and sea and air patrols to avoid these danger zones (U.S. Department of Commerce, 1975). Launches are programmed to confine potentially dangerous debris to these danger areas, although some debris may fall outside the designated zones. There are no known instances of missile debris from Vandenberg impacting or threatening marine traffic.

Air Transportation. There are five active airports in the vicinity of Vandenberg. They are located in Santa Barbara, Santa Ynez, Santa Maria, Lompoc, and Vandenberg. These and others are indicated in Figure 1-33. Flight operations include jet air carriers, air taxis, and military aircraft, but the vast majority of operations are general aviation (Southern California Association of Governments, 1973). Operations are summarized in Table 1-25.

Table 1-25. Aircraft operation in Santa Barbara (U.S. Department of Transportation, 1977; Vandenberg AFB, 1977).

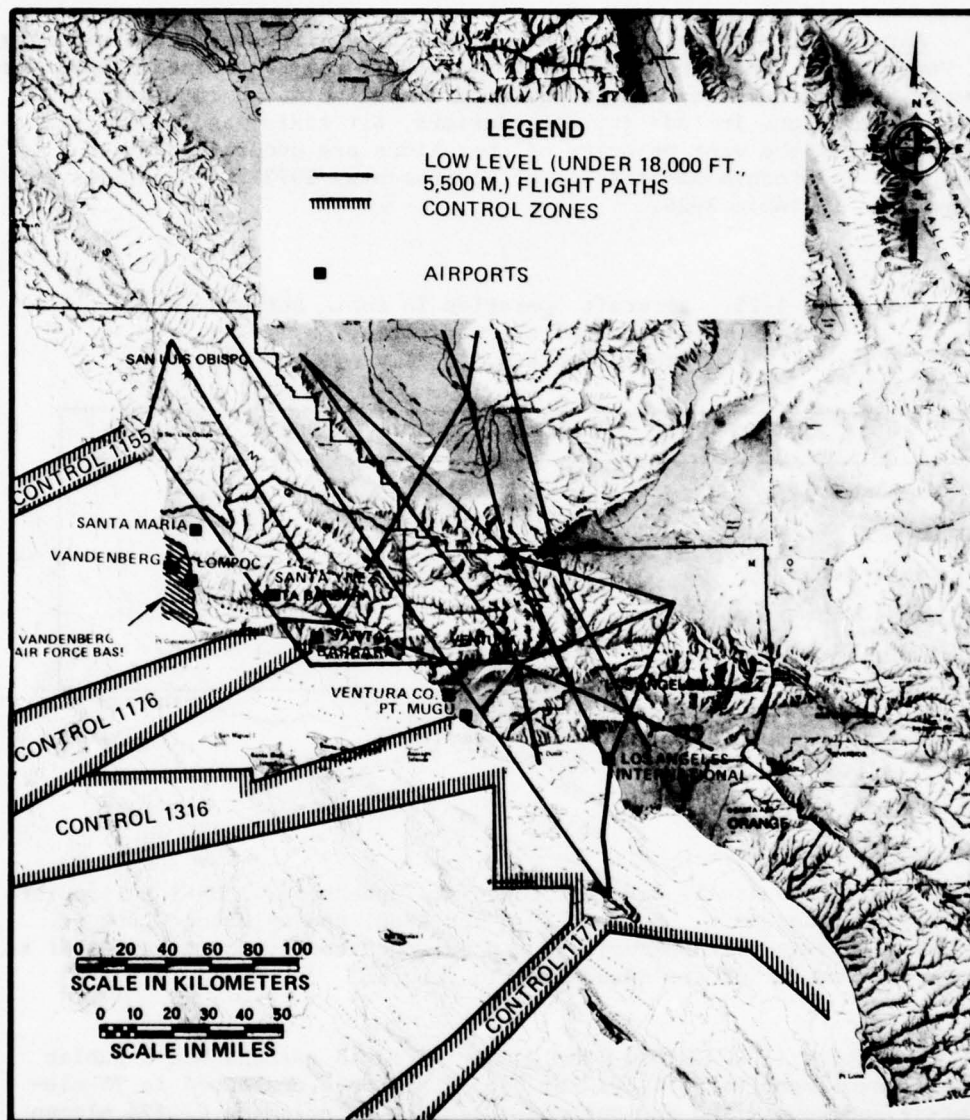
AIRPORT	BASED AIRCRAFT	ANNUAL OPERATIONS ¹
Vandenberg	11	3,600
Lompoc	40	15,300
Santa Maria	91	58,000
Santa Ynez	30	13,000
Santa Barbara Municipal	213	105,000

372T-3025

¹Does not include touch-and-go operations.

Presently, there are 11 aircraft based at Vandenberg, 3 UH-1 helicopters, and 8 Aero Club craft. Between 1979 and 1980, the existing 8,000 ft (2,438 m) runway will be replaced and extended to 15,000 ft (4,572 m) to meet requirements of the Space Shuttle Program.

Education (1.2.2.3.5). The County of Santa Barbara had a public school enrollment in Fall 1977 of 54,585 students contained in 75 elementary and 36 unified and secondary schools. There are 22,474 elementary students, 30,148 unified and secondary students, and 3,016 teachers for an overall student to teacher ratio of about 17 to 1 (Santa Barbara County Schools, 1977a). The county also has 31 parochial and private or special schools, with reported 1976 enrollments totalling 5,300.



372P-367-3

Figure 1-33. Air transportation corridors in the vicinity of Vandenberg AFB.

The Lompoc Unified School District has 2 senior high, 3 junior high, and 11 elementary schools with a total Fall 1977 enrollment of 9,590 including 4,495 elementary and 5,095 secondary students. The elementary and secondary schools have a current capacity for 8,800 and 6,560 pupils, respectively (Lompoc Unified School District, 1978). The student-teacher ratio is about 20 to 1 (Santa Barbara County Schools, 1977a). The 1977-1978 average cost per student in the Lompoc District is \$1,587 (Santa Barbara County Schools, 1977b). In the last several years, the District has experienced declining enrollments, especially in the elementary levels, and two primary schools have been closed.

Twenty-six elementary and junior high schools in seven districts serve the Santa Maria area. In 1978, 3 out of the 4 high schools were overcrowded. Neither double sessions nor major new construction of facilities is contemplated to alleviate this situation. Since the elementary schools within the District have had a decline in recent enrollments, students in excess of capacity within the high schools may be a temporary phenomenon. The cost per student at Santa Maria high schools is \$1,970, while the cost in area elementary schools averages \$1,848. Student-teacher ratios in elementary and high school districts average 18 to 1.

In the Santa Ynez Valley, the high school, with 861 students is at two-thirds of capacity. An additional 700 students could attend without overtaxing facilities or space. Five smaller elementary school districts operate within the area served by the high school district. Per pupil expenditures for secondary students amount to \$2,177 and for the elementary pupils average \$1,670 (Santa Barbara County Schools, 1977b).

There are several institutions providing opportunities for higher education in Santa Barbara County. The largest of these is the University of California at Santa Barbara, with a total Winter 1978 enrollment of 14,097 (University of California at Santa Barbara, 1978). The city of Santa Barbara also has a city college with a February 1978 enrollment of 8,465 (Santa Barbara City College, 1978). Santa Maria had a Fall 1977 enrollment of 8,523 at Alan Hancock Junior College (Alan Hancock Junior College, 1978).

Over 4,500 students attend one of the seven colleges providing educational programs at the education center on base. These classes are designed primarily for the needs of the military personnel and their dependents, but are also open to civilians in the surrounding communities. Associate, Bachelors, and Masters degrees can be earned in residence. Courses are also offered towards a Ph.D. in selected fields (Vandenberg AFB, 1977).



Since the 1920s, the University of California at Santa Barbara has expanded from a small teacher's college in the city of Santa Barbara to its present size and location on former Marine Corps land adjacent to the Santa Barbara Airport. This institution presents quality instruction and is the second largest single employer in the county behind Vandenberg.

Community Safety and Health Services (1.2.2.3.6). Community safety and health services addressed in this section include police protection, fire protection, and medical services.

Police Protection. Offbase, the County Sheriff's office serves the residents of the unincorporated area of Santa Barbara County with a staff of 237 officers in 1978 (Santa Barbara County Sheriff, 1978); of this number, 135 are patrol officers. This allows for 1.1 officers for each 1,000 people.

The city of Santa Maria has 50 police officers and 4 police aides to protect its estimated 1977 population of 33,800, for a ratio of 1.4 officers per 1,000 population. The smaller city of Lompoc supports a police force of 31 officers for its 1977 population of approximately 24,150. This averages 1.2 officers per 1,000 population.

Fire Protection. Santa Barbara County has 169 firefighters providing fire and rescue service to some 1,322 mi² (3,421 km²), with a ratio of 1.3 firefighters to 1,000 persons. Firefighting facilities onbase are centered around the seven fire stations scattered over the base. A total force of 144 firefighters is available on a 24-hour basis with three fire trucks, eight pumpers, five water distributors, and four support vehicles. Mutual aid agreements exist between Vandenberg and the county of Santa Barbara, the city of Lompoc, and the city of Santa Maria. These agreements allow for mutual firefighting without reimbursement between Vandenberg and these firefighting units. Vandenberg can request and pay a fee for the use of air tankers owned by the U.S. Forest Service in Los Padres National Forest. Firefighting facilities are considered adequate except for fires under extremely strong wind conditions, such as those which were experienced in the fire onbase in December 1977.

Medical Services. Santa Barbara County contains numerous medical services to support its 280,000 residents. There are 10 acute care hospitals and 19 skilled nursing care facilities currently in operation,

Brush fire is an everpresent danger in Central California. This fire threatening homes in Vandenberg Village was brought under control before extensive damage was done. During 1977-1978, brush fires took four lives and destroyed over 200 homes in Santa Barbara County.



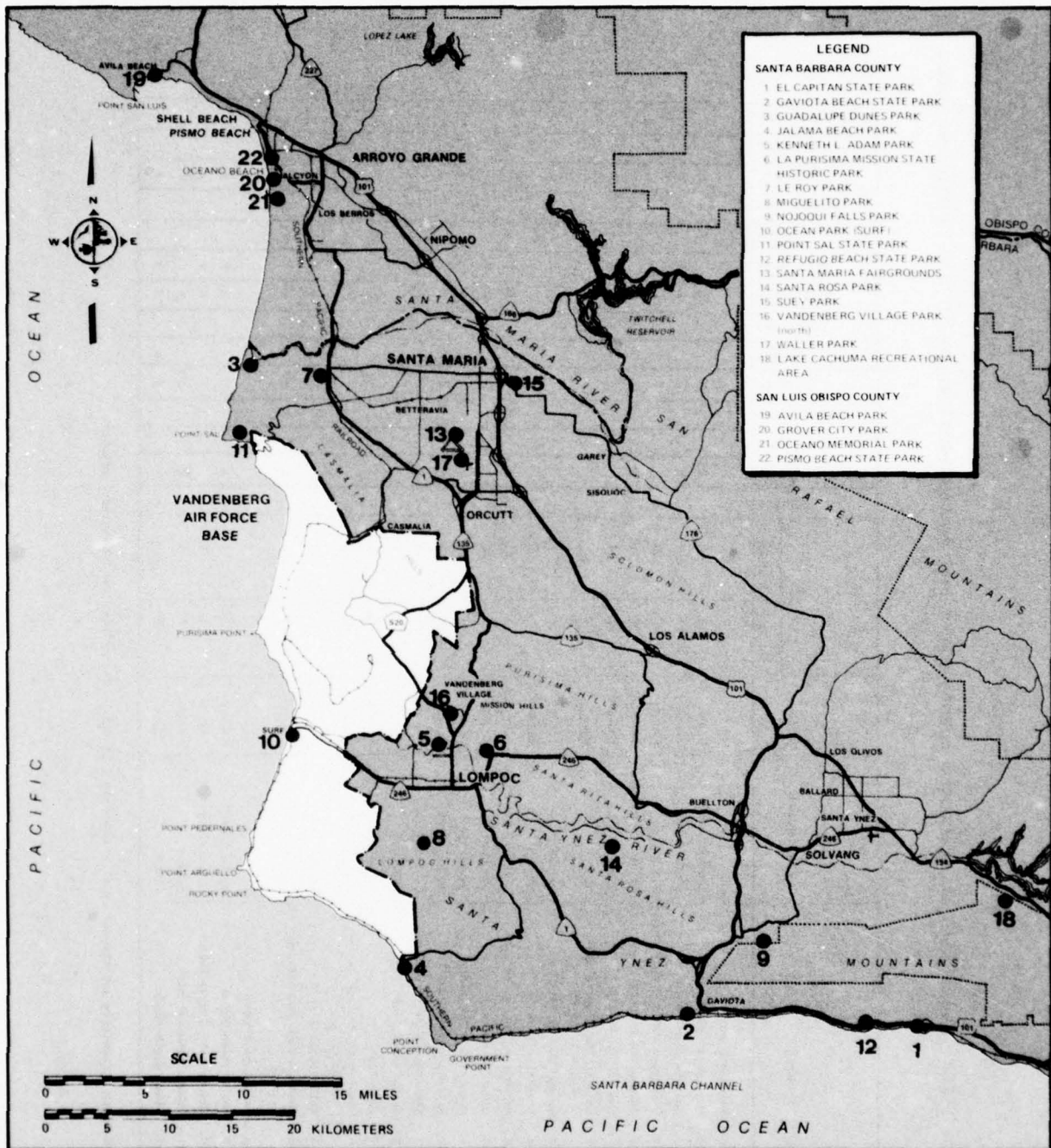
as well as two intermediate facilities, three institutions offering acute psychiatric care, and several ambulatory care facilities (California Office of Statewide Health Planning and Development, 1977). There are approximately 550 physicians and surgeons practicing in Santa Barbara County (Santa Barbara County Medical Society, 1978). This would allow for almost two physicians or surgeons per 1,000 people.

Recreation (1.2.2.3.7). The Lompoc-Santa Maria Valleys' natural recreational assets and the interest of local residents have resulted in the establishment of numerous local, county and state recreation facilities within the area. Recreational sites and activities on Vandenberg are numerous and are growing in number.

- Parks. Community parks, public beaches, golf courses, and wilderness areas are all found within the immediate Vandenberg vicinity. Recreational activities at these facilities include swimming, boating, surfing, surf fishing, hiking, biking, camping, barbecuing, field sports, golfing, picnicking, and riding. Parks within Santa Barbara County and in southern San Luis Obispo County are shown in Figure 1-34. Activities, facilities, and acreages of these parks are summarized in Table 1-26.
- Recreational Housing. There are four major ways in which nonpermanent residences are provided in and around a community: apartments, motels, campgrounds, and trailers in mobile-home parks. In the North County area, all four types exist and represent varying capacities to accommodate nonpermanent residences. The current number of motel rooms and range of price in the three major areas surrounding Vandenberg provide an indication of future trends and are presented in Table 1-27.

Towns nearby Vandenberg AFB have no overnight public campgrounds but the offbase towns of Santa Maria, Lompoc, or Buellton do offer some mobile-home parks providing spaces for overnight trailers, short-term trailers, and other recreational vehicles. The city of Santa Maria has a limited capacity for such accommodations, with only 3 of the 15 mobile-home parks providing a total of 14 spaces. Lompoc provides a few additional spaces for transients, with 4 mobile-home parks out of 6 supplying 36 overnight spaces and one park providing space, if available. Buellton has overnight accommodations with 2 major mobile-home parks providing approximately 222 spaces, some with and some without hookups.

A number of recreational areas are located on the base itself. Camping facilities consist of a 20-space family camp on 4 acres (1.6 ha) west of the cantonment area, with water, electricity, showers, and rest-rooms available. One of the largest recreational projects onbase is the expanded San Antonio Picnic Grounds. Built on 50 acres (20 ha) in an isolated



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Table 1-26. Facilities at state and county parks and recreational areas in the Vandenberg area.

NAME	LOCATION	OWNERSHIP	AREA		BOATING	CAMPING	EVENTS/EXHIBITS	FIELD SPORTS	FISHING	HIKING	HISTORIC	PICNICKING	PLAYGROUND	RIDING	SKIN DIVING	SWIMMING	TENNIS	UNDERDEVELOPED
			(Acres)	(Hectares)														
Santa Barbara County																		
1. El Capitan State Beach	South Coast	State	111	44		X			X			X				X		
2. Caviota State Park	South Coast	State	2,796	1,118	X	X			X			X				X		
3. Guadalupe Dunes County Park	Guadalupe	County	26	10					X			X						
4. Jalama Beach County Park	Point Conception	County	28	11		X			X			X						
5. Kenneth L. Adam Park	Lompoc	Federal	61	24								X						
6. La Purisima Mission State Historic Park	Lompoc	State	903	361			X				X							
7. Le Roy County Park	Guadalupe	County	4	1.6								X						
8. Miguelito Park	Lompoc	County	4	1.6								X						
9. Mojave Falls County Park	South of Solvang	County	83	33		X		X				X						
10. Ocean Beach Park (Surf)	Lompoc	County	40	16	X				X			X						
11. Point Sal State Beach	Guadalupe	State	49	20					X			X						
12. Refugio State Beach	South Coast	State	39	16	X				X			X						
13. Santa Maria Fairgrounds	Santa Maria	State	36	14		X			X			X						
14. Santa Rosa County Park	Buellton	County	21	8									X					
15. Suey Park	Santa Maria	County	19	8								X						
16. Vandenberg Village Park (North)	Lompoc	County	20	8										X				
17. Waller County Park	Santa Maria	County	154	62				X				X						
18. Cachuma Lake Recreational Area	East of Santa Ynez	County	6,448	2,579	X	X		X	X	X		X				X		
San Luis Obispo County																		
19. Avila State Beach	Avila Beach	County	3.5	1.4	X	X						X				X		
20. Grover City County Park	Grover City	County	3	1.2								X						
21. Oceano Memorial Park	Oceano	County	7	3		X			X			X						
22. Pismo State Beach	Pismo	State	959	384	X	X			X	X		X				X		

3727-3026

Sources: Livingston and Blayney et al., 1974; San Luis Obispo County Planning Department, undated.

Table 1-27. Motel rooms and price ranges for Santa Maria, Lompoc, and Buellton/Solvang.

LOCATION	NUMBER OF ROOMS (1977)	PRICE RANGE ¹	PREVALENT PRICE RANGE
Santa Maria	1,066	\$8 to \$38	\$14 to \$18
Lompoc	314	\$8 to \$30	\$14 to \$21
Buellton/Solvang and Vicinity	539	\$8 to \$38	\$22 to \$35

372T-3027

¹Price ranges subject to seasonal variations.

Sources: Santa Maria Valley Chamber of Commerce, 1978; Lompoc Valley Chamber of Commerce, 1978; Solvang Chamber of Commerce, 1978.

but accessible valley, these grounds provide baseball diamonds, volleyball courts, a playground, picnic tables, barbecue facilities, and overnight camping for campers with tents or recreational vehicles. Capacity of the grounds is 1,000 people at any one time and about 300 people per month utilize the area. Boy Scout and Girl Scout camps are also located nearby. Three other picnic grounds exist onbase: Minuteman Beach, Surf Beach, and Middle Pine Canyon Lake. Minuteman and Surf combined total 20 acres (8 ha) with a capacity of 1,200 people, while Middle Pine Canyon Lake can hold 200 people on 5 acres (2 ha).

The natural wildlife controlled within the borders of the base provide adequate game stock for hunters. Hunting is permitted on about 70 percent of the base, with the remainder specified as wildlife control areas. California wild boar, deer, band-tailed pigeon, mourning dove, brush rabbit, and water fowl hunting occur in season. Both fresh- and saltwater fishing are available. Onbase inland lakes and the rugged coastal areas provide ample catch to civilian and military fishermen; in 1977, approximately 2,500 civilians were given access to beaches for surf fishing. Estimated total revenues in fiscal year 1977 from hunting and fishing permits totalled nearly \$9,800. These funds are used to finance fish and wildlife related projects such as stocking of trout and deer herd management.

Three miles (4.8 km) of bike paths, 15 mi (24 km) of hiking trails, and 110 mi (176 km) of equestrian trails have been established in natural areas of the base. About 180 horses are stabled in converted World War II tank sheds and provide the basis for the base's Saddle Club. An 18-hole golf course is available and is used by about 3,700 people each month. Offroad vehicles are allowed on 1,200 acres (480 ha) of designated land west of the cantonment.

Cultural Resources (1.2.2.3.8). La Purisima Mission State Historical Park, located just northeast of the city of Lompoc, and Los Alamos Ranch House, west of Los Alamos, are the only nationally recognized historical sites in the Vandenberg region. Both are included in the *National Register of Historic Places*. La Purisima was not hemmed in by modern building, hence it has been completely restored, the only such total restoration of a California mission.

Other recorded sites of historic interest in the area include: Artesia School, a Santa Barbara County landmark on the outskirts of Lompoc; Jesus Maria Rancho Adobe, located near Casmalia Road on the eastern edge of Vandenberg AFB; Point Arguello, a historic shipping point; the Elizalde Adobe in Betteravia; Guadalupe Ranch House, Nos. 1 and 2, in Guadalupe; the Point Conception Light Station at the west entrance to the Santa Barbara Channel; San Ramon Chapel, 15 mi (24 km) southeast of Santa Maria; Sisquoc Church, a county landmark in the Sisquoc area; Santa Rosa Adobe in the Lompoc area; and the Wickenden and Foxen Adobes in Foxen Canyon.

The currently unused Coast Guard Station and Boathouse located approximately 3 mi (4.8 km) southeast of Point Arguello on the base was constructed in 1938 and used as a dwelling for Coast Guard personnel who tended the lighthouse crash boat support facilities and rescue operations (Vandenberg AFB Real Estate Office, 1975). In September 1977, the Coast Guard Station-Boathouse was determined to be eligible for inclusion in the *National Register of Historic Places* by the California State Office of Historic Preservation. The final disposition of the Complex has not been decided and communication between the state and the Air Force on the matter is continuing (California State Department of Parks and Recreation, 1978).

Archaeology (1.2.2.3.9). Vandenberg Air Force Base lies within the territory that was occupied during late prehistoric and historic times by the Chumash Indians. "Chumash" is a linguistic term that is applied to the people who inhabited the southern California coast from Malibu to Estery Bay, including the Santa Barbara Channel Islands. The Chumash lived in large permanent villages, made possible by an efficient maritime adaptation. Craft specialists produced ornamental artifacts of shell, bone, and stone in the Late Chumash period, and there is evidence of complex trading networks (King, 1971).

Spaniards in ships contacted the Chumash as early as 1542, but prolonged contact between these two groups did not begin until late in the third quarter of the 18th Century. The first historical accounts date from Portola's expedition of 1769, and La Purisima Concepcion Mission, one of the five Spanish missions located in the Chumash area,

was founded in 1787. The missions brought together different Chumash groups, reducing dialect difference between villages. The major effects of the mission program in Santa Barbara County were a disruption of the Indians' traditional way of life and reduction of their population through disease. Organized Chumash culture no longer existed by 1840.

Ethnohistoric studies of the Chumash have been an important source for the development of archaeological models of the settlement—subsistence systems that characterized the Vandenberg area in historic and late prehistoric times (Spanne, 1971, 1974; Glassow, et al., 1976). As additional archaeological data are accumulated, they can be used to modify these models to account for the settlement-subsistence systems of earlier time periods. Sites within Vandenberg are representative of all three periods that are recognized in the prehistory of Santa Barbara County: Late Horizon (Canalino or Chumash), A.D. 1000-1850, Middle Horizon, 3000-1000 B.C.; and Early Horizon 6000-3000 B.C.

According to Glassow and Spanne, the sequence of changes in prehistoric adaptive strategies in the Vandenberg area is similar to that which has been reported for the Santa Barbara Channel. However, the Middle Horizon type of adaptation may have begun at an earlier date here than elsewhere. The Early Horizon was characterized by the collection of seeds for food. The Middle Horizon was characterized by the hunting of land and sea mammals, the increasing importance of fishing, and a possible shift to different kinds of seeds. During the Late Horizon period, fishing was of major importance, but wild seeds were still collected. Shellfish were an important resource throughout these periods.

The major economic resources exploited by the Chumash seem to be concentrated in two kinds of areas: favorable coastal zones and along perennial streams farther inland. Favorable coastal areas were generally those that were the most protected from the prevailing northwesterly winds. Fish, shellfish, marine mammals, and migratory waterfowl were more abundant in these areas and could be more efficiently exploited. In such areas, large, sedentary villages tended to be established. In areas of unprotected coast, villages tended to be established along perennial streams slightly inland from the coast. This setting offered several plant resources, freshwater fish, land mammals, and waterfowl as potential food resources. Settlement in the interior was apparently less sedentary than in favorable coastal settings.

Archaeologically Sensitive Areas. Since the data gathered during previous studies on Vandenberg have received only preliminary analysis, the approach followed here is to develop a tentative map of the variability of archaeological sensitivity at Vandenberg utilizing only published reports. This is accomplished by first developing a simple typology of archaeological sites on Vandenberg, and then presenting a set of criteria for measuring archaeological sensitivity.

Spanne (1971, 1974) defined six major site types on Vandenberg, with one of these types having five separate subtypes. For present purposes, Spanne's assignment of sites to particular categories has been accepted and all of Spanne's types are collapsed into two general categories: multiple activity sites and limited activity sites.

The category, multiple activity site, implies residence on at least a seasonal, if not a permanent, basis. Evidence of a wide range of activities such as food procurement, preparation, and consumption; tool manufacture and maintenance; disposal of the dead; and performance of ritual might be expected to occur archaeologically.

The category, limited activity site, implies an occupation as brief as a few minutes but not much longer than a few days. Usually evidence of only a few specialized activities such as stone tool manufacture or procurement of a particular food resource is manifested in the archaeological record. Table 1-28 summarizes the relationship between Spanne's types and the two general types defined above. Ideological sites are tentatively included with multiple activity sites due to their potential religious significance to Native American groups and because of their potential for development into public interpretive displays.

Table 1-28. A simplified typology of archaeological sites on Vandenberg AFB.

MULTIPLE ACTIVITY SITES
Sedentary or Semisedentary Villages
Seasonal Villages or Intermittently Occupied Habitation Sites
Historic Spanish or Mexican Period Sites
Historic Anglo Sites
Ideological Sites
LIMITED ACTIVITY SITES
Hunting-Related Sites
Fishing/Shellfishing/Marine Hunting Sites
Plant Food Gathering or Processing Sites
Quarry Sites

The two most recent archaeological surveys on Vandenberg were done in connection with the Space Shuttle program (Glassow, 1976, 1977), the spacing between field crew members was kept at about 100 ft (30 m) and the area was covered in a zig-zag pattern. As a result, a higher percentage of the smaller, less visible sites were located compared to earlier surveys. The survey team located and recorded an additional 39 archaeological sites during the 6-week survey of the Space Shuttle project area.

Archaeological researchers on Vandenberg have emphasized that the relatively undisturbed state of both the archaeological resources and their environmental setting provide the opportunity for the scientific study of the full range of culturally patterned behavior in this area and its change through time. Given this situation, the basic premise followed is that all of the archaeological resources on Vandenberg are significant, and should be preserved to the maximum extent possible. Based upon the known high density of archaeological remains on Vandenberg, it is unlikely that total avoidance of archaeological sites will always be possible and therefore multiple activity sites should be considered more significant--and therefore less expendable--than are limited activity sites.

There are a number of reasons for the greater significance of multiple activity sites relative to limited activity sites at Vandenberg:

- Limited activity sites are more numerous. Thus, it is likely that other similar sites will occur in nearby undisturbed areas. Therefore, future researchers with improved methods and different research questions will still have an adequate resource base to study.
- Present archaeological method and theory provides a reasonably efficient framework for recovering information from sites containing small amounts of material culture deposited under rather simple conditions. For example, at limited activity sites artifacts were often discarded where they were used and often were subject to no post-depositional disturbance. To a large extent, work at limited activity sites can aid in the development of the method and theory required for maximum information recovery from multiple activity sites with complex depositional histories.
- It is unlikely that limited activity sites contain cemeteries where the ancestors of living Native Americans were buried. Preservation of these cemeteries is of concern to Native Americans in general, and for the Vandenberg area it is of specific concern to several Native American groups in Santa Barbara and San Luis Obispo counties (Glassow, 1976).

A preliminary map of archaeological sensitivity on Vandenberg Air Force Base (Figure 1-35) was developed in the following manner. First, all multiple activity sites were plotted on a map. On a transparent overlay, all areas containing and immediately adjacent to multiple activity sites were designated as zones of very high archaeological sensitivity. Next, all limited activity sites were plotted on a second map. On the same transparent overlay, all areas which showed a high density of limited activity sites (based on visual inspection, an admittedly subjective approach) were designated as having moderate-to-high archaeological sensitivity. The remaining areas of the base were desig-

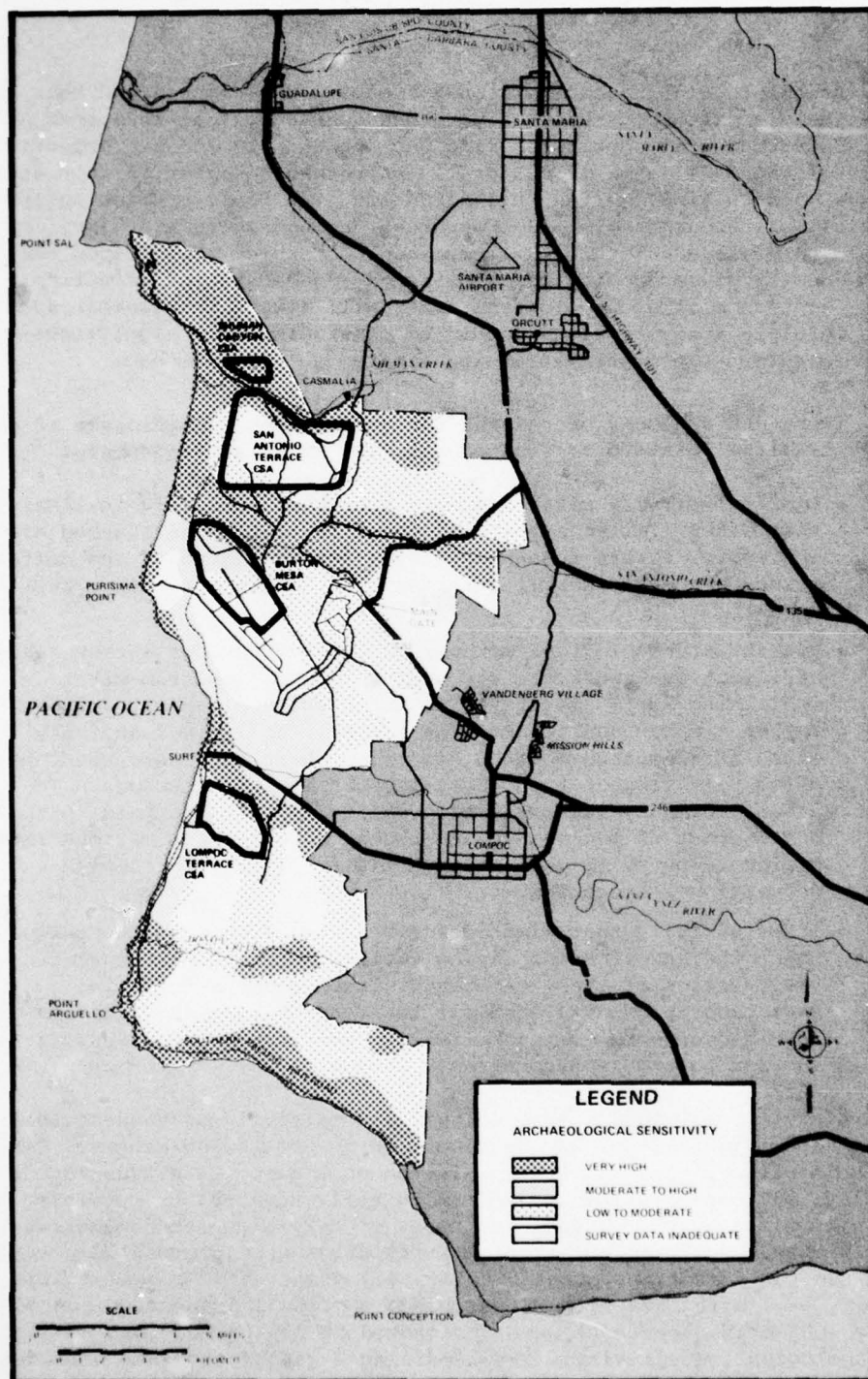


Figure 1-35. Archaeological sensitivity on Vandenberg AFB.

nated as zones of low-to-moderate sensitivity. When the areas indicated by Spanne (1974) as requiring additional survey are plotted, they fall almost entirely within the low-to-moderate sensitivity zone. This original survey work was concentrated in areas of expected high-site density, with only cursory attention given to suspected low-density areas. Therefore, the empirical basis for classifying areas in the low-to-moderate sensitivity zone is not as good as for the other two zones.

Energy (1.2.2.3.10). Power for onbase uses is provided primarily by offbase commercial utility companies which supply Vandenberg (and the rest of Santa Barbara County) with electricity and natural gas.

Electricity. The northern portion of Santa Barbara County is within the service territory of Pacific Gas and Electric Company (PG&E), which includes Lompoc, Santa Maria, and Vandenberg. No problems in providing electricity to current or projected customers are anticipated at this time (Pacific Gas and Electric Company, 1977; Southern California Edison, 1977).

Natural Gas. The natural gas supplier for all of Santa Barbara County is Southern California Gas Company. At this time, Southern California Gas provides a service to new residential customers in the area upon request; however, new large users [over 50,000 ft³/day (1,415 m³/day)] may not be permitted to receive service because of the current low supply of natural gas. The availability of natural gas is largely controlled by Federal Power Commission allocation to the suppliers of the Southern California Gas Company. Limited curtailment of firm users is expected by 1978 unless new domestic sources are developed or liquified natural gas supplies become available from outside the continental United States (Southern California Gas Company, 1977).

Vandenberg is supplied with natural gas through a 6-inch gas main operating at a pressure of 250 to 400 psig, with a current contracted total supply rate of 885,500 mcf (25×10^9 m³) per year (mcf = thousand cubic feet). The current gas consumption rate is approximately 750,000 mcf (21×10^9 m³) annually, which is about 15 percent less than the contracted maximum consumption rate.

Water Reserves (1.2.2.3.11). The heavy demand for both domestic water and irrigation water in Santa Barbara County has made water supply one of the most important public issues. Table 1-29 summarizes water resources supply and demand characteristics. Figure 1-36 presents the groundwater basins in Santa Barbara County. The situation is most critical on the South Coast Basin where the Goleta Water Board is enforcing a moratorium on new hookups and the Montecito Water District has instituted rationing measures. This shortage could conceivably be ended in

Table 1-29. Summary of supplies and demands for Santa Barbara County in 1975 (in acre-feet [million m³]).

AREA OF BASIN	AVAILABLE SUPPLIES		TOTAL AVAILABLE SUPPLY	ESTIMATED DEMAND	SUPPLY-DEMAND	REMARKS
	SURFACE WATER	GROUND-WATER				
Santa Barbara Basin	16,250 (20)	2,500 (3)	18,750 (23)	16,050 (19.8)	+2,700 (3)	Santa Barbara greatly benefits from its Gibraltar system.
Goleta Basin	9,310 (11.5)	4,200 (5)	13,510 (16.5)	17,600 (21.7)	-4,090 (5)	The actual surface deliveries to GOMD ¹ in 1975 were greater than the volume shown, due to the availability of surplus water. Additional NRS ² water was taken in advance to fulfill the demand.
Gaviota to Point Conception Area	—	2,000 (2.5)	2,000 (2.5)	1,000 (1.2)	+1,000 (1.2)	
Santa Ynez Uplands Basin	3,850 (4.9)	11,000 (13.6)	14,950 (18.4)	16,550 (20.4)	-1,600 (1.9)	
Santa Ynez Riparian Basins	200 (0.25)	25,350 (31.3)	25,550 (31.5)	25,550 (31.5)	—	Cachuma water was supplied to SMID ³ . It is assumed throughout this report that supplies in the Santa Ynez Riparian Basins will equal demand. This is a result of the live stream criteria as modified by the NRS, which allows an accumulation of downstream release credits.
Lompoc Area	280 (0.35)	27,000 (33)	27,000 (33.3)	31,500 (38.8)	-4,500 (5.5)	This demand includes water consumed by phreatophytes as well as underflow to the ocean totalling 3,150 AFY (3.8 x 10 ⁶ m ³).
San Antonio Basin	—	9,500 (11.7)	9,500 (11.7)	12,800 (15.8)	-3,300 (4.1)	This represents the total demand on the basin both in Santa Barbara and San Luis Obispo counties.
Santa Maria Basin	2,100 (2.6)	105,500 (105)	105,500 (105)	133,500 (165)	-28,000 (34.5)	The Santa Barbara County portion of the demand is 110,000 AFY (136 x 10 ⁶ m ³) and 23,500 AFY (29 x 10 ⁶ m ³) in San Luis Obispo County.
Cuyama Basin	—	10,600 (13)	10,600 (13)	32,000 (39.5)	-21,400 (26.4)	This does not include the San Luis Obispo County portion demand of 36,475 AFY (45 x 10 ⁶ m ³).
Other Santa Barbara County	7,017 (8.7)	11,700 (14.4)	18,717 (23.1)	14,800 (18.3)	-3,917 (4.8)	Goleta-West Conduit water delivered to this area included as part of the total supply and demand on the Goleta Basin, not the Ellwood-Gaviota area.
Total	36,727 (45.3)	209,350 (258)	246,077 (304)	301,350 (372)	+55,273 (68)	

¹Goleta Community Water District

²New Release Schedule

³Solving Municipal Improvement District

Source: Santa Barbara County Water Agency, 1977b.

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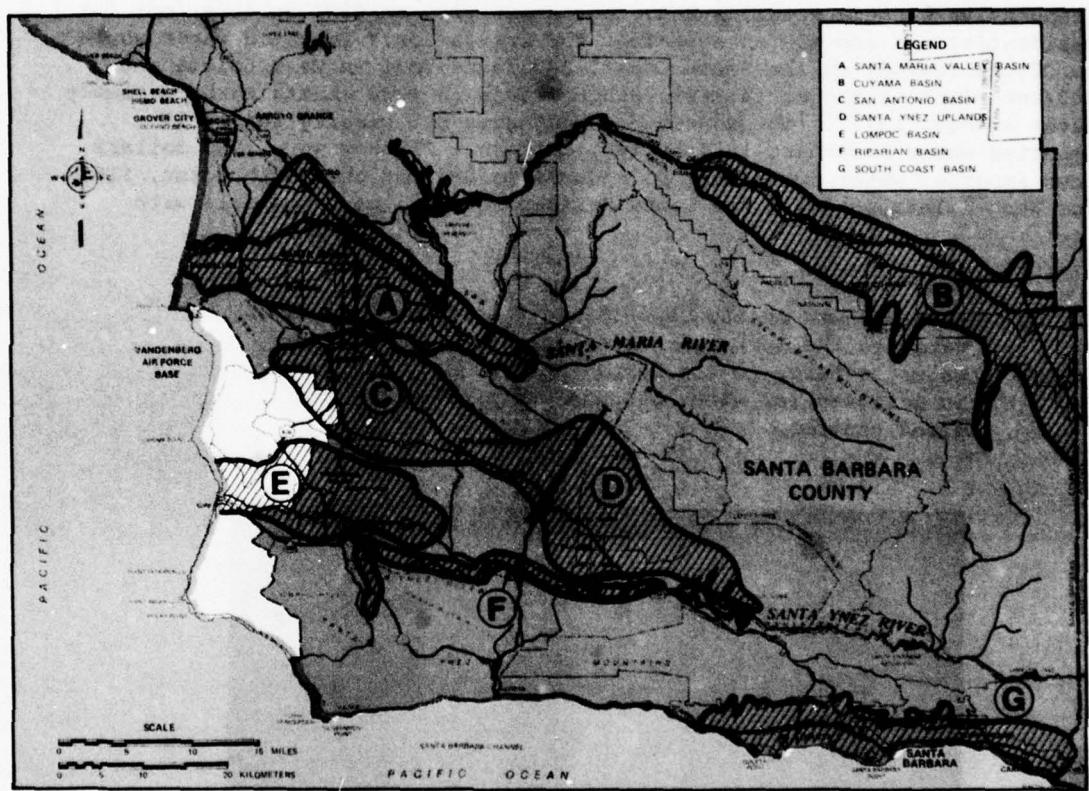
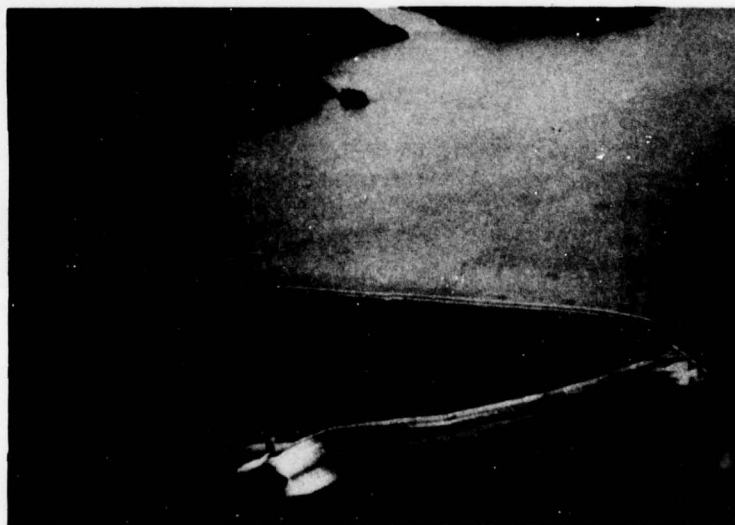


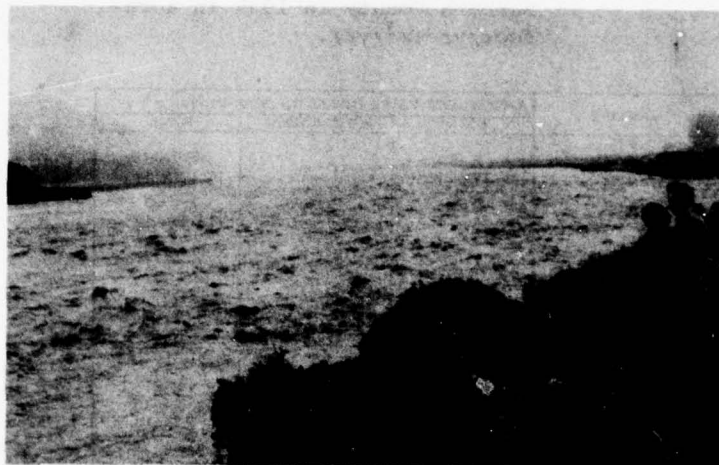
Figure 1-36. Groundwater basins in Santa Barbara County.

1985 with the completion of a Coastal Aqueduct to import water from the State Water Project. Santa Barbara County has entered into an agreement with the state for delivery of water in annual amounts up to 57,700 acre-feet per year. "No growth" advocates throughout the county have campaigned for a delay in the project while "growth" advocates and agricultural interests have pushed for early implementation. The South Coast area is also looking at alternative water sources including the temporary importation of Santa Ynez groundwater. However, such alternative solutions would not relieve potential water problems in the rest of the county.

Financing of a Coastal Aqueduct is a local controversial issue. Current water costs vary with groundwater basin, are moderated by relatively inexpensive Cachuma water, and average about \$100 to \$200 an acre-foot for residential use and \$50 an acre-foot for irrigation. Imported water would be \$204/acre-foot on the South Coast, \$363/acre-foot in West Goleta and \$42/acre-foot in the Santa Maria-Sisquoc area in 1990 (Santa Barbara County Water Agency, 1977). The source document does not clearly report if imported water costs are 1975 or 1990 dollars. If they were 1990 dollars then imported water costs must be reduced to \$94 for the South Coast, \$167 for West Goleta, and \$19 for Santa Maria-Sisquoc to be comparable with

Lake Cachuma on the Upper Santa Ynez River supplies water to the Santa Barbara-Goleta area and groundwater recharge to the Santa Ynez Valley. The lake is designed for water storage and recreation, not flood control.





Twice in the past decade floodwaters of the Santa Ynez River have cut the main road between North and South Vandenberg. Such river floods as the one above in 1978 turn an essentially dry river bed into a 1/2 mi (0.8 km) wide 20 ft (6 m) deep torrent that destroys bridges, sewer lines, and road crossings in the Santa Ynez and Lompoc valleys.

current costs. The adjustment assumes 8 percent inflation for 1975 to 1980 and 4 percent inflation for 1980 to 1990 or an average rate of 5.32 percent for 15 years (Santa Barbara County Water Agency, 1977). Costs of imported water would be reduced somewhat (about 3 percent) if a 25 percent subsidy were allowed for capital costs.

Streams in the area can flood during heavy precipitation. The general slope of creek drainages contributes to rapid runoff and peak discharge to the ocean. However, little data are available on floods outside of developed areas. Recently, damage resulted from two Santa Ynez River floods. The first and largest flood had a peak discharge of 100,000 cfs (2,830 m³/sec) and the smaller subsequent flood had a peak flow of 70,000 cfs (1,981 m³/sec). Floods of these magnitudes are rare, however.

In a special report, the staff of the Santa Barbara County Water Agency estimated the urban and agricultural water demand of the localities in the county. These estimates are given in Table 1-30. Approximately 75 percent of all water used in the county is for agriculture. North County consumes about 83 percent of the total county demand while the

Table 1-30. Estimated water demand in Santa Barbara County in 1975 in acre-feet/yr (m^3/yr).

LOCALITY	APPROXIMATE WATER DEMAND IN ACRE-FT/YR (m^3/yr)		
	URBAN	AGRICULTURAL	TOTAL
Vandenberg AFB	5,000 (6.17×10^6)	—	5,000 (6.17×10^6)
Lompoc Valley*	5,800 (7.15×10^6)	29,200 (36.0×10^6)	35,000 (43.0×10^6)
San Antonio Valley*	400 (0.49×10^6)	10,100 (12.4×10^6)	10,500 (13.0×10^6)
Santa Maria Valley	20,100 (24.8×10^6)	94,900 (116.4×10^6)	114,500 (141.2×10^6)
Santa Ynez Valley	3,300 (4.07×10^6)	31,000 (38.2×10^6)	34,200 (42.2×10^6)
South Coast	35,000 (43.2×10^6)	13,800 (17.0×10^6)	48,800 (60.2×10^6)
Other Areas	400 (0.49×10^6)	31,800 (39.2×10^6)	32,200 (39.7×10^6)
Total County	70,000 (86.3×10^6)	210,300 (260×10^6)	280,300 (346×10^6)

*Excluding Vandenberg AFB.

Source: Santa Barbara County Water Agency, 1977.

South Coast accounts for only 17 percent. Vandenberg's demand of approximately 5,000 acre-ft/yr ($6.2 \times 10^6 m^3/yr$) is less than 2 percent of the county total.

In most cases the total available supply for the groundwater basins as shown in Tables 1-29 and 1-30 are for extractions and were calculated assuming overdrafting to meet demands. Total available supply is the sum of the surface water supplies and the groundwater basin safe yields for extraction. The estimated demand represents both agricultural and municipal and industrial demands by public and private purveyors. Supply minus demand indicates whether or not adequate water will be available. Positive numbers indicate surpluses, while negative numbers indicate deficits.

Judging from the overall difference between the water supply and demand, it is apparent that demand surpasses supply by more than 55,300 acre-feet per year ($68 \times 10^6 m^3$). Unless other sources are introduced to the region, the growth in the region will be limited by the water supply deficit experienced in the county as a whole.

The water demand at Vandenberg in 1975 was about 5,000 af/yr ($6.2 \times 10^6 m^3$). The present 10 wells onbase are adequate for present water demands. The future supply for some wells would depend on the demands in the rest of the county, especially the wells from the Lompoc Plains system which is the last downstream user of the aquifer. Operation of these wells in

Lompoc Valley may be discontinued if the water quality continues to deteriorate because of overdrafting by upstream users.

Water Supply at Vandenberg. Vandenberg's surface water supplies are limited by seasonal stream flow and are not used for domestic purposes. Surface water onbase occurs in small permanent lakes, streams, and ponds. The five small lakes onbase which cover a combined area of 27.3 acres (11 ha) have a combined volume of slightly over 200 acre-ft ($247 \times 10^3 \text{ m}^3$). They are: Punchbowl Lake [13.6 acres (5.4 ha)], Mod III Lake [9.6 acres (3.8 ha)], and Upper, Middle, and Lower Canyon Lakes.

At Vandenberg, substantial quantities of groundwater occur in the Lompoc Valley along Santa Ynez River and in the San Antonio Valley along the San Antonio Creek. Groundwater is also available in the Lompoc Terrace area.

The total withdrawal in the San Antonio Valley is 10,000 acre-ft/yr ($12 \times 10^6 \text{ m}^3$), compared with an estimated potential yield of 7,000 acre-ft/yr (8.6×10^6), and the total withdrawal in the Lompoc Valley area is 16,000 acre-ft/yr (19.7×10^6), while the estimated potential yield is 15,400 acre-ft/yr (19×10^6) (Livingston and Blayney, 1974). In the alluvial aquifer in the San Antonio Valley south of San Antonio Terrace, the water table occurs at an approximate elevation of 10 to 30 ft (3 m to 9 m) (Muir, 1964). The unconsolidated deposits which fill the bottom of the San Antonio Valley are river channel and alluvial deposits of Holocene age, underlain by the Paso Robles Formation and Careaga sand. The primary aquifer in the valley is the Holocene deposits. Water is also produced from the underlying Paso Robles Formation. As of 1964, the piezometric surface (the maximum level to which the water will rise) at the west end of the San Antonio Valley was high enough to preclude salt water encroachment.

Water is also being pumped from the Lompoc Terrace from two wells at the combined rate of 230 acre-ft/yr (0.28×10^6). Evenson and Miller (1963) estimated that the available storage of groundwater in the Lompoc Terrace is 60,000 acre-ft (74×10^6) and that the Lompoc Terrace aquifers could sustain a pumping rate of no more than 500 gpm ($2 \text{ m}^3/\text{min}$). Under present conditions, much of the groundwater recharging to the Lompoc Terrace eventually discharges into the aquifers in the Lompoc Valley to the north. As of 1963, the piezometric level in the western end of the Lompoc Valley had not been reduced to a level where salt water intrusion could occur (Evenson and Miller, 1963).

All of Vandenberg's water supplies are pumped from groundwater sources via ten wells located onbase. The base does not acquire any water from surface supplies or from contract sources. In terms of total pumpage, the main portion of the supply currently comes from the western end of the Lompoc Plain aquifer near the mouth of the Santa Ynez River. The next largest contributing source of water for the base is the western portion

of the San Antonio aquifer. Finally, South Vandenberg is supplied with water from the aquifer under the Lompoc Terrace.

Water from the San Antonio aquifer, where two new wells were completed in 1977, is expected to provide the greater portion of the base's requirement through the mid-1980s. After that time, it is estimated that overdrafting by upstream users will deplete this source to the extent that a new supplemental water source will be required.

The Lompoc Terrace aquifer is the only supply which is contained almost entirely beneath federal property and is, therefore, less subject to withdrawal by other users. It is a relatively small basin [approximately 60,000 acre-ft (74×10^6)] in which wells yield only about 500 gpm ($2 \text{ m}^3/\text{min}$) at moderate to high drawdown. This small aquifer, however, is expected to supply the requirements of the South Vandenberg area for at least the next 20 years.

Wastewater (1.2.2.3.12). Wastewater treatment facilities in the area include government-owned plants at Vandenberg and the Federal Correctional Institution (FCI), city-owned plants at Lompoc and Santa Maria, and the Laguna County Sanitation District plant serving rural Santa Maria Valley. The South Coast area of Santa Barbara County is served by a variety of local public works departments and sanitary districts.

- Vandenberg. Domestic sewage at Vandenberg comes from four sources: The North Vandenberg cantonment area, the South Vandenberg industrial area, outlying technical facilities, and the mobile home park. Industrial sewage comes only from the component cleaning facility and the photo laboratory. All are in compliance with Environmental Protection Agency standards.
- The cantonment area sewage is treated at the existing secondary treatment plant, built in 1942, a biofiltration (trickling filter) type with a capacity of 3-million gallons per day gpd. The average daily flow is 1.1 million gpd and the peak flow in the past has been 1.6 million gpd. Infiltration of up to 0.3 mgd occurs during periods of heavy rainfall. The North Vandenberg sewerage system is to be connected with the new Lompoc Regional Wastewater Reclamation Plant via a 10-mile (16 km) interceptor sewer line scheduled for completion by March 1979. At that time, the existing treatment plant and beach outfall will be abandoned.
- South Vandenberg. Sewage treatment in this area is accomplished by a series of lagoons which treat the raw sewage through the natural processes of sedimentation and breakdown by aerobic bacteria.
- Dispersed Areas. Topography and distance are such that it is not always possible to have a central treatment plant or to

connect to an existing sewage system; consequently, septic tanks with drain fields and 16-related aeration plants located at remote sites are in use.

- Federal Correctional Institution (FCI). The new secondary treatment facility at the FCI in Lompoc which went online in January 1977, has a 0.3 mgd (1,140 m³) design capacity to serve a maximum of 2,350 people. No future expansion is anticipated. Average daily flow is 0.25 mgd (950 m³) with all wastewater being reclaimed for irrigation purposes.
- Lompoc. The city of Lompoc has recently upgraded their wastewater treatment plant. The new facility, which went online in July 1977, increased the city's capacity from 1.76 to 5 mgd (6,700-19,000 m³). The plant, which serves as a regional facility, presently gives high-grade secondary treatment to about 2 mgd (7,600 m³) of sewerage from Lompoc plus 0.39 mgd (1,480 m³) from Vandenberg Village. This represents a service population of 35,000 persons. Maximum service capacity is approximately 50,000 persons. Vandenberg AFB was invited to participate in the regional plant in 1971 and declined. New negotiations started in April 1976 which have led to a decision for Vandenberg to join the new facility. Vandenberg AFB will add approximately 1.6 mgd (6,060 m³) to the plant's load. Treated wastewater from the facility is discharged into the Santa Ynez River at a present rate of approximately 2.23 mgd (8,450 m³).
- Santa Maria. The incorporated areas of Santa Maria (population approximately 35,000) are served by a city-owned secondary treatment facility with a design capacity of 6.5 mgd (24,600 m³). Average daily flow for the fiscal year ending June 1977 was 5 mgd (19,000 m³) with a peak flow of approximately 7 mgd (26,500 m³) (Santa Maria Department of Public Works, 1977b). Santa Maria has a new treatment facility in the design stage to expand their capacity and to improve inadequate disposal of treated wastewater. The new facility, which is expected to go online by early 1981, will have a maximum capacity of 7.8 mgd (29,500 m³) which can serve a population of about 39,000.
- Santa Maria Valley. The Laguna County Sanitation District serves the rural areas of Santa Maria Valley. The unincorporated population is about 21,000 and the system is designed for a capacity of approximately 29,400. Secondary level treatment is given to an average flow of 1.5 mgd (5,680 m³).
- Santa Ynez Valley. The Solvang Municipal Improvement District wastewater treatment facility and a facility under the direction of the Buellton Community Services District have combined average daily flow of approximately 0.56 mgd (2,120 m³) and serve a population of 5,200.

Solid Waste Disposal (1.2.2.3.13). Solid waste disposal facilities in the vicinity of Vandenberg include sanitary landfills operated by the cities of Santa Maria and Lompoc, the Casmalia Class I Disposal Site operated by private enterprise, and the Vandenberg landfill operated by the base. Each of these sites has a remaining life of at least 15 years, and with expansion of some sites and future resources recovery programs, these existing sites should adequately serve the local residents and the base.

Solid waste control onbase includes a sanitary landfill, three incinerators, a recycling program, and a building disposal program. Approximately 150,000 cubic yards (24,720 m³) per year are collected and deposited in the onbase sanitary landfill at the southeast side of the cantonment area. The landfill is operated according to EPA and USAF rules and regulations. It is located in a canyon head which prevents wind-scattering of material and prevents the landfill from being an aesthetic nuisance. The road into the site is paved as far as practical to prevent dust. This site has capacity for 20 to 30 years at the present rate of fill. There are other areas available for similar disposal.

Toxic and Hazardous Materials Management. The base has plans and programs to deal with the handling, storage, and disposal of all hazardous materials generated onbase. The Toxic and Hazardous Materials portion of the Base Disaster Preparedness Plan and the Oil Spill Prevention Control and Countermeasure Plan (Base OPSLAN 233-76) cover all contingencies concerning toxic and hazardous material spills on base property.

Currently the base toxic and hazardous waste storage and treatment facility is just south of Purisima Point. The Bioenvironmental Engineering Service is responsible for determining which wastes can be neutralized onsite and reviewing the necessary procedures to accomplish such treatment in a safe manner. All materials which cannot be treated and disposed of onbase are taken to the Class I Disposal Site north of Casmalia. Privately operated, the site is strictly controlled by the State of California Coastal Regional Water Quality Control Board.

Toxic materials generated by missile operations on Vandenberg AFB are disposed of in accordance with state and county requirements. As an example, normal Minuteman system operations onbase generate weak chromate solutions as waste. Water pollution controls forbid their disposal through the sewage system. Therefore, a procedure has been established to dispose of these wastes on a quarterly basis at the Casmalia Class I Disposal Site (see Glossary for disposal site, Class I).

The Oil Spill Prevention Control and Countermeasures Plan was revised. The plan, in conjunction with AFM 88-12, provides the following:

- diking of all above-ground storage tanks to prevent any possible spills
- cathodic protection systems for all below-ground storage tanks

- yearly inspection of all storage tanks
- a reporting procedure for all spills
- a team, trained, equipped, and exercised in the containment, collection, and disposal of all hazardous substances stored on base
- other requirements of above and below-ground tanks to prevent any possible spills.

The Petroleum Products Recovery Program provides for salvaging and reusing petroleum products where possible. The Missile Propellant Waste Program outlines procedures for the disposal of waste, residual, and contaminated (not within specifications) missile propellants.

Additionally, Vandenberg is listed in the Resource Availability Directory of the 12th Coast Guard Oil and Hazardous Substances Pollution Contingency Plan which was updated in July 1976. According to the agreement with the Coast Guard, the base will provide men and equipment should a major spill occur in the local area.

Environment of the Candidate Siting Areas (1.2.3)

Detailed site-specific environmental characteristics presented in this section permit evaluation and comparison of the impacts of MX construction and operation activities at each of the CSAs.

Shuman Canyon Candidate Siting Area (1.2.3.1)

- Geomorphology. Shuman Canyon CSA is on the actively eroding southern slope of the Casmalia Hills. The area has been shaped by complex drainages cutting across a relatively flat terrace. The east-west trending drainage that traverses the CSA is developed along the axial area of a small syncline (Jennings, 1977). The steepness of the terrain to the northeast and east has rendered this CSA unsuitable for a trench mode facility. Elevations within the CSA range from 60 to 430 ft (18 m to 130 m).
- Geology and Seismicity. Located on the south flank of the faulted anticlinal Casmalia Hills, the Shuman Canyon CSA has a great variety of exposed rock types, surficial deposits and structure (Figures 1-37 and 1-38). Much of the site is underlain by the Todos Santos Claystone member of the Sisquoc Formation (Woodring and Bramlette, 1950). The western part of the candidate siting area is underlain by the Monterey Formation in fault contact with the Sisquoc Formation locally.

SITE GEOLOGY EXPLANATION

LITHOLOGY

UPPER JURASSIC(?)	PLEIS- TOCENE	Qal	RECENT ALLUVIUM
		Qs	RECENT DUNE AND BEACH SAND
		Qds	OLDER DUNE SAND
		Qt	TERRACE DEPOSITS, UNDIFFERENTIATED
	MIOCENE	Qo (Qo(?))	ORCUTT FORMATION: Qo(?) - OLDER TERRACE DEPOSITS OF PROBABLE ORCUTT AGE
		Tsq (Tsts)	SISQUOC FORMATION: Tsts - TODOS SANTOS CLAYSTONE MEMBER
		Tmu Tmm Tml	MONTEREY FORMATION: Tmu - UPPER MEMBER, Tmm - MIDDLE MEMBER, Tml - LOWER MEMBER
	PLIOCENE	Tps	POINT SAL FORMATION
		TI	LOSPE FORMATION
		Jf	FRANCISCAN FORMATION, UNDIFFERENTIATED

MAP SYMBOLS




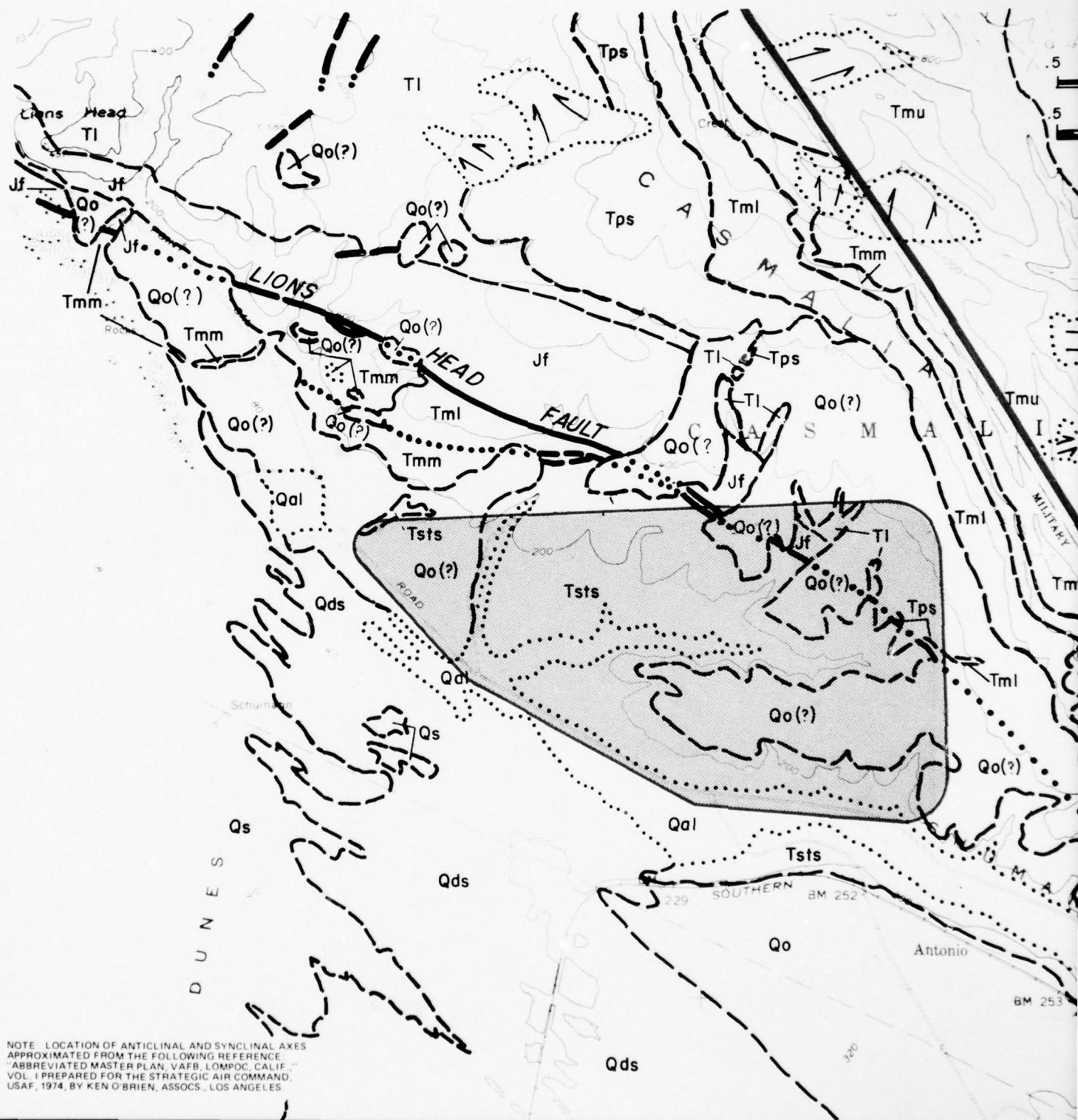
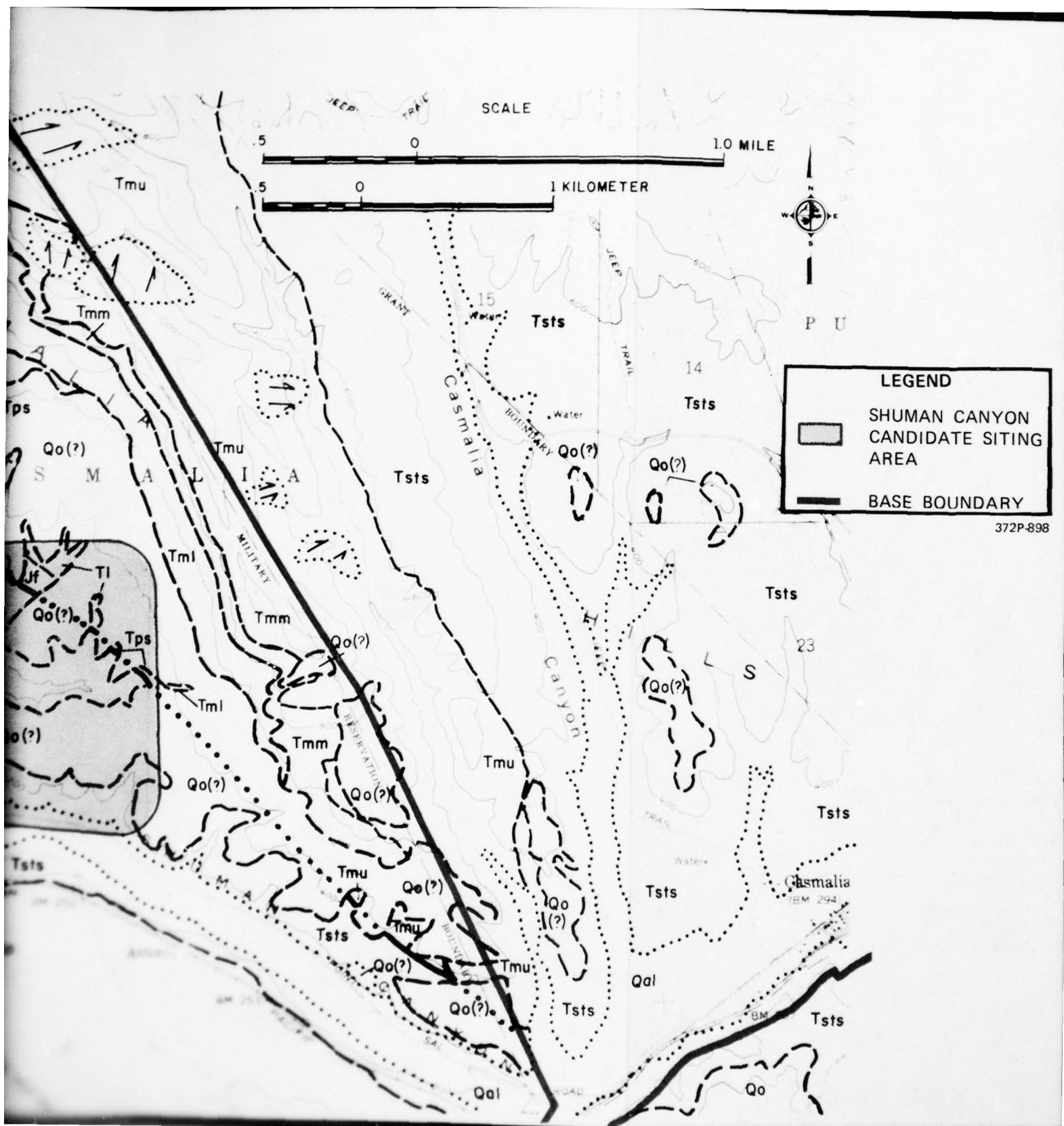
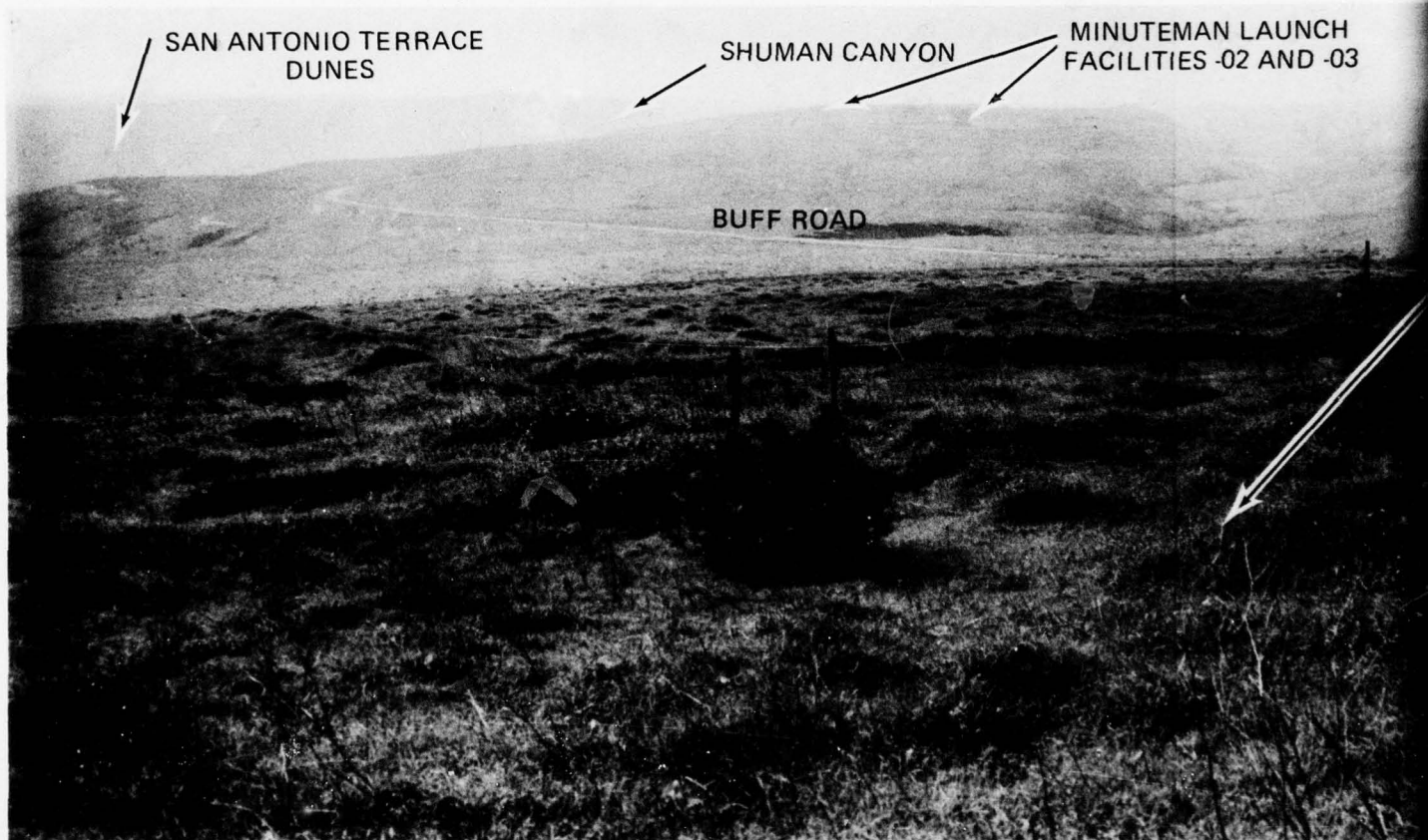
	CONTACT
DASHED WHERE APPROXIMATELY LOCATED; DOTTED WHERE CONCEALED	
	FAULT
DASHED WHERE APPROXIMATELY LOCATED; DOTTED WHERE CONCEALED	
	LIMITS OF EXISTING LANDSLIDE

Figure 1-37. Explanation for geology figures.

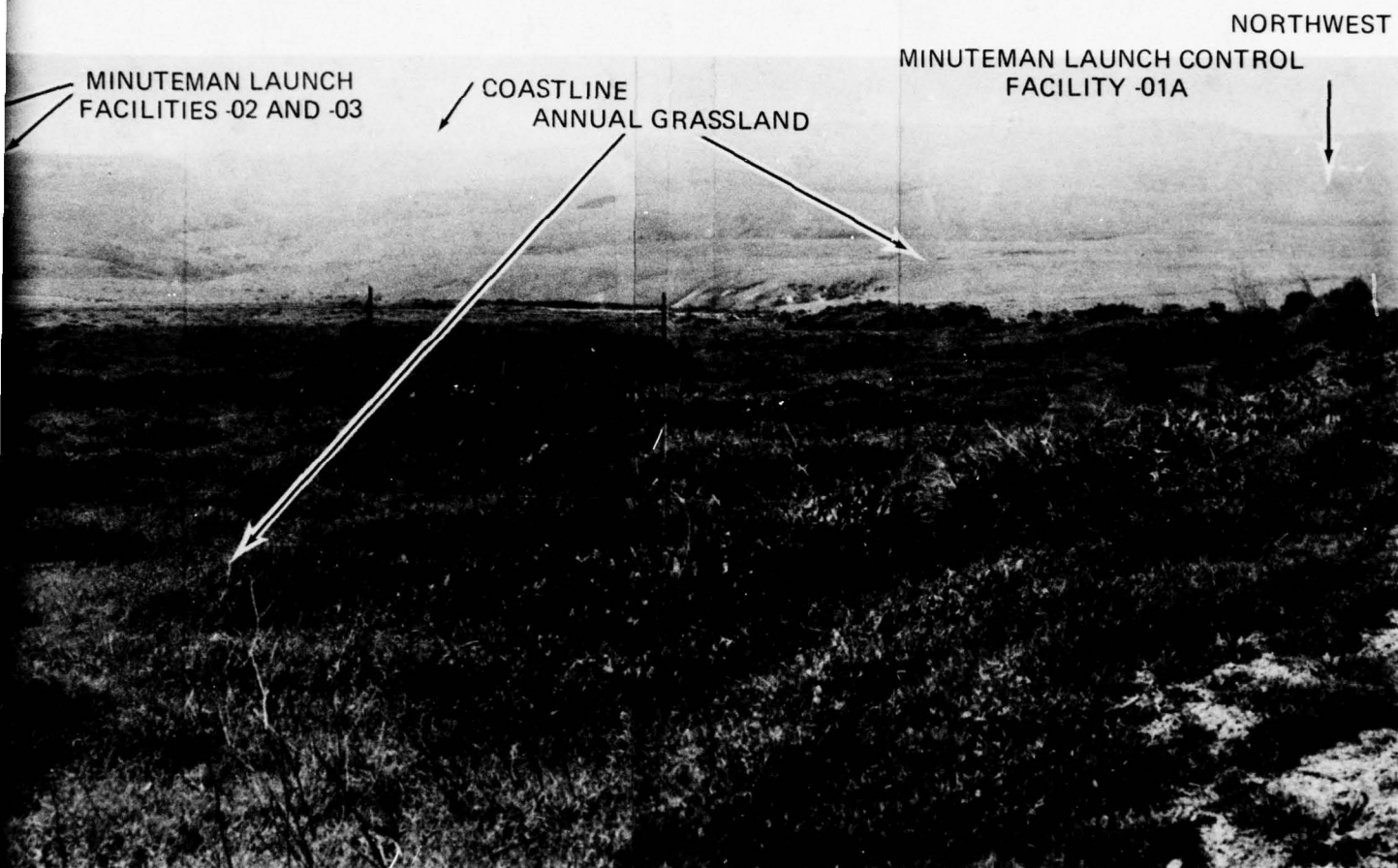




SOUTHWEST



The
flank
land
grass
being
Creek
the



372P-816-1

The Shuman Canyon Candidate Siting Area is located at the foot of the southern flank of the Casmalia Hills. The terrain is generally well-drained, sloping land cut by several small drainage courses and covered with disturbed annual grassland. Many slopes are in excess of 10 percent, the notable exception being a flat-topped terrace area just north of and parallel to Shuman Canyon Creek. The MX launch facilities are conceptually sited on this terrace near the present locations of Minuteman launch facilities -02 and -03.

The Lions Head fault passes to the north side of this candidate siting area, bordering the south side of the Casmalia Hills, and has a mapped length of 5 mi (8 km). At its western end, the fault intersects the coastline and is seen as a 50-ft (15 m) breccia zone. Sylvester and Darrow (1977) have indicated that the fault has displaced Quaternary terrace deposits in this vicinity. Along most of its length, the main trace of the fault has juxtaposed Franciscan basement rock north of the fault against Tertiary Monterey Formation south of the fault, and it is intermittently blanketed by terrace deposits (Figure 1-38). The total displacement is not known. A splay fault from the main fault is located to the south and juxtaposes the lower member of the Monterey against the middle member of the Monterey (Woodring and Bramlette, 1950).

The mapped offshore projection of the Lions Head fault intersects the Hosgri fault about 4 mi (6.4 km) offshore from Point Sal. The eastern extension of the fault onshore is not mapped at the surface although the orientation of the closely packed, step-like anticline on the north side of the Purisima Hills is indicative of a buried left-lateral fault aligned with the Lions Head Fault.

Ground shaking and surface faulting can occur at this candidate siting area and could cause structural damage to structures located on or proximal to seismic movement or ground rupture. Liquefaction is not expected to occur. Flooding due to inundation by seismic seawaves or peakstorm runoff is unlikely, based on topography and historic records. The siting area is topographically higher than the areas of potential flooding. The relatively steep slopes at Shuman Canyon CSA could experience landsliding and local cut slope failures.

- Mineral Resources. No mining activities have occurred at the Shuman Canyon CSA. Mineral deposits are not known to exist nor are mining activities planned in the future. Exploratory oil wells are located both along the ridge north of the candidate siting area in the Casmalia Hills and south of Shuman Canyon on San Antonio Terrace, but no oil exploration has occurred within this candidate siting area.
- Paleontology. The Sisquoc Formation has yielded fauna of mollusks within the section, and the Monterey Formation contains a large number of microscopic foraminifera, and fewer gastropods and pelecypods. The Orcutt sand has yielded a meager fauna of ostracods and mollusks. No collecting localities have been identified.
- Soils. The soils of the Shuman Canyon CSA are formed on shale bedrock, terrace deposits and surface, windblown deposits. The soils are thin and consist primarily of silty sand and clayey silts. Field observations and soil borings indicate that the

engineering properties of soils underlying the area are expansive for depths up to 15 or 20 ft (4.6 to 6 m). Compressible soils in the Shuman Canyon CSA are found only in the flat bottom canyons and in Shuman Canyon itself.

- Hydrology. The Shuman Canyon CSA is located to the north of Shuman Canyon Creek in the Casmalia Hills. Shuman Canyon Creek enters the ocean on the northern border of Vandenberg, approximately 4 mi (6.4 km) north of San Antonio Creek. It is 9 mi (14 km) long and drains an area of about 21 mi² (54 km²).

Two small unnamed tributaries of Shuman Canyon Creek pass through the Shuman Canyon CSA. Each tributary is ephemeral in nature and has a typical dendritic pattern which includes several smaller streams. The more westerly of the two basins has a drainage area approximately 0.5 mi² (1.3 km²); and ranges in elevation from 80 to 1,400 ft (24 to 427 m) mean sea level (MSL). The mean annual flood in this basin is estimated to have a peak flow of 20 ft³ (0.6 m³) per second and the 100-year flood is estimated to have a peak flow of 1,000 ft³ (28 m³) per second (Young and Cruff, 1967). The second basin, located to the east of the first, has a drainage area of approximately 1.7 mi² (4.4 km²) and ranges in elevation from 80 to 1,320 ft (24 to 400 m). The mean annual flood in this basin is estimated to have a peak flow of 44 ft³ (1.2 m³) per second and the 100-year flood is estimated to have a peak flow of 3,500 ft³ (99 m³) per second (Young and Cruff, 1967). Floods within these small drainage basins are usually of short duration and occur as the result of high intensity rainfall. As is the case with many streams of the vicinity, the flow rates in Shuman Canyon Creek probably range from zero in the dry months to several cubic feet per second in flood periods. The steep slope of the watershed implies that local flooding from high-intensity rainfall is likely.

- Groundwater Hydrology. The Shuman Canyon CSA is underlain primarily by the nonwater bearing Monterey Formation. Locally some areas may contain relatively thin and discontinuous layers of terrace or other unconsolidated deposits (Arnold and Anderson, 1907). The only groundwater likely to occur within this area would be in the form of zones of perched water associated with the terrace deposits, and in the alluvial fill in Shuman Canyon Creek. There are no records of any water wells at the Shuman Canyon CSA. This area is not considered as a recharge zone for local aquifers.
- Archaeology. The Shuman Canyon CSA lies within an area that has been surveyed and archaeological site density is known to be very high. Spanne (1974) describes this as one of the four densest areas on Vandenberg in terms of existing archaeological remains. Only two known sites occur within this CSA. Both

sites are large, one is a limited activity site while the other is a multiple activity site. Since site density is high immediately to the north and south of the Shuman Canyon CSA, it is suspected that additional survey work associated with specific road alignments alternatives could result in the location of more sites.

- Terrestrial Biology. Terrain in the vicinity of the Shuman Canyon CSA is rather heterogeneous and includes only limited areas of level or nearly level ground. Vegetation is largely annual grassland on the upland areas inland of the highway comprising the candidate siting area itself (Figure 1-39). The annual grassland is a vegetation type resulting from disturbance. It is difficult to tell whether any of the area on the base was originally grassland. It is clear, however, that extensive areas once in chaparral or coastal sage scrub have been converted into this type which is dominated by introduced annual grasses (*Bromus*, *Avena*, *Festuca*, *Hordeum*, etc.). A large number of native annual wildflowers may exist as seeds among the grasses and appear *en masse* in the springtime in favorable years; however, Coulombe and Cooper (1976) imply that the native annual flora in the annual grassland is somewhat sparse due to continued overgrazing. In the area of the mouth of Shuman Canyon Creek adjacent to the CSA, the terrain consists primarily of stabilized dunes containing both strand and coastal sage scrub elements. Shuman Canyon itself contains a riparian community and the north-facing wall of the canyon supports coastal sage scrub vegetation with some chaparral.

The sand dunes, in a rather narrow zone behind the beach, are covered by widespread strand species such as the sand verbenas (*Abronia maritima*, *A. umbellata*, and *A. latifolia*), beach morning glory (*Calystegia* [= *Convolvulus*] *soldanella*), beachbur (*Ambrosia* [= *Franseria*] *chamissonis* subsp. *bipinnatisecta*), a goldenbush (*Haplopappus venetus*), a live-forever (*Dudleya* cf. *farinosa*), and the naturalized introductions Hottentot fig (*Carpobrotus* [= *Mesembryanthemum*] *edulis*) and sea rocket (*Cakile maritima*). Beach grass (*Ammophila arenaria*), originally planted in order to stabilize the dunes, is now extensively established in the area and is aggressively spreading at the expense of the native species. Proceeding inland, this strand vegetation gradually merges into the stabilized dune phase of coastal sage scrub.

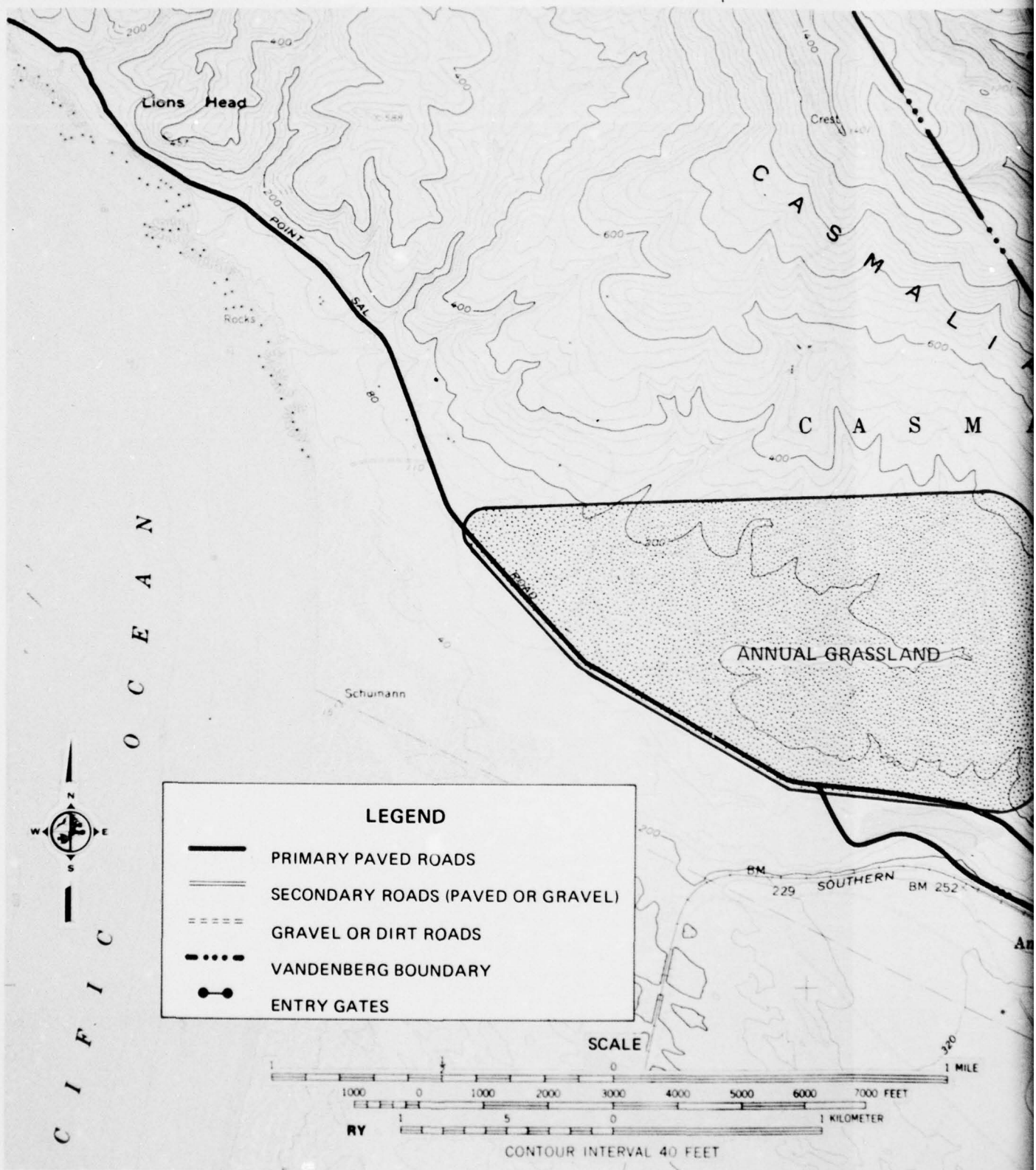
The mouth of Shuman Canyon marks the northern limit of the extensive sand dune formations on Vandenberg. The stretch of similar dunes north of the base from near the mouth of the Santa Maria River to the vicinity of Pismo Beach are under pressure from expanding suburban development and intensive recreational activity.

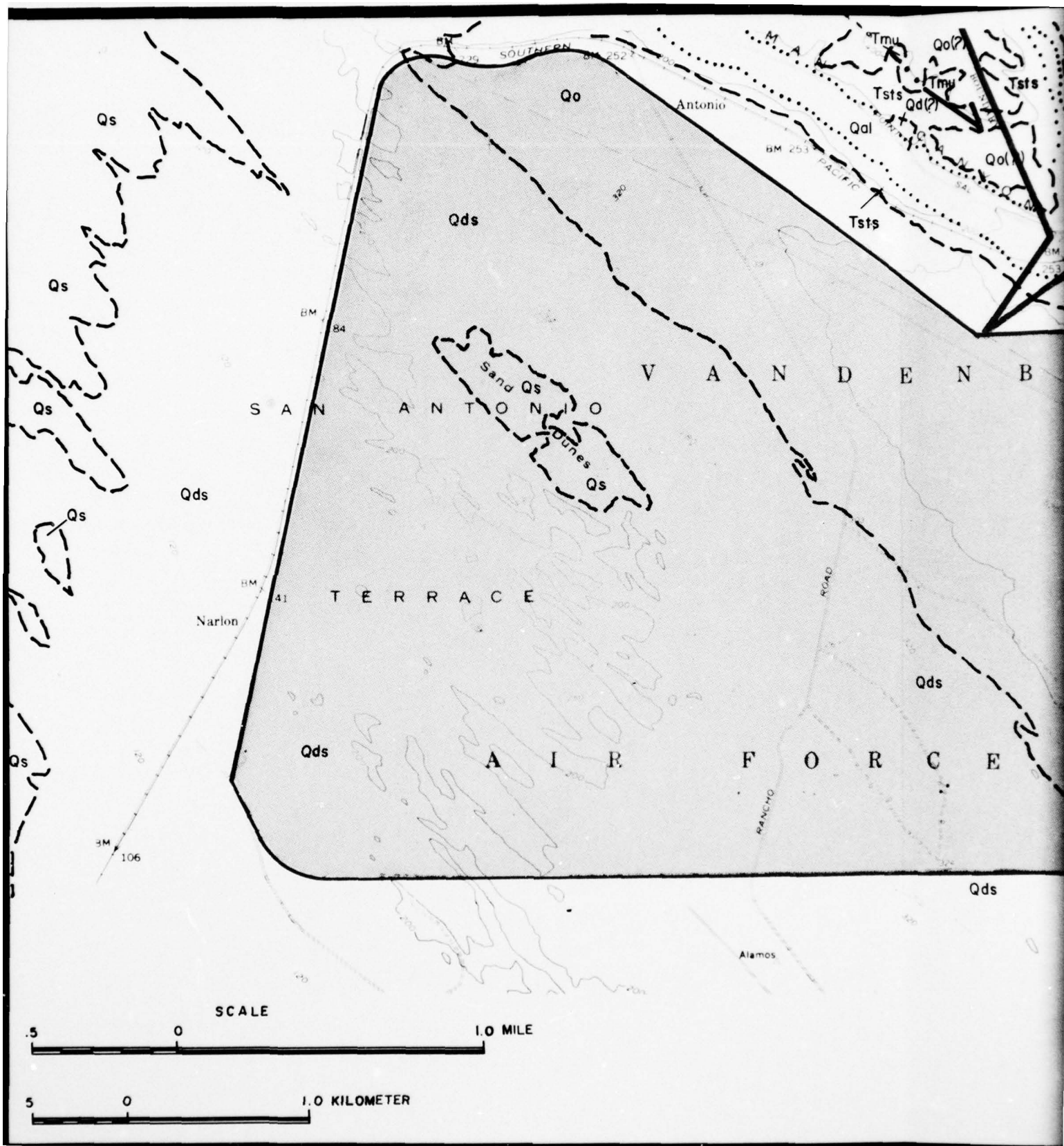
- Aquatic Biology. Shuman Canyon Creek is located between the Shuman Canyon CSA and the San Antonio Terrace CSA. The creek has an intermittent flow and is generally 3 to 10 in. (7.6 to 25.4 cm) deep (Coulombe and Cooper, 1976). Few aquatic or riparian plants are present with only willows and green algae noted. Treefrogs (*Hyla* sp.) and red-legged frogs (*Rana aurora*) were the only fauna observed, although other species may be present. In the lagoon, ostracods, amphipods (*Melita californica*), freshwater snails, and insect larvae occur (SAMSO, 1976) along with the tidewater goby (*Eucyclogobius newberryi*) and Pacific staghorn sculpin (*Leptocottus armatus*). Several aquatic birds also frequent the river and lagoon including the California brown pelican, gulls, sandpipers, surf scoters, and plovers.

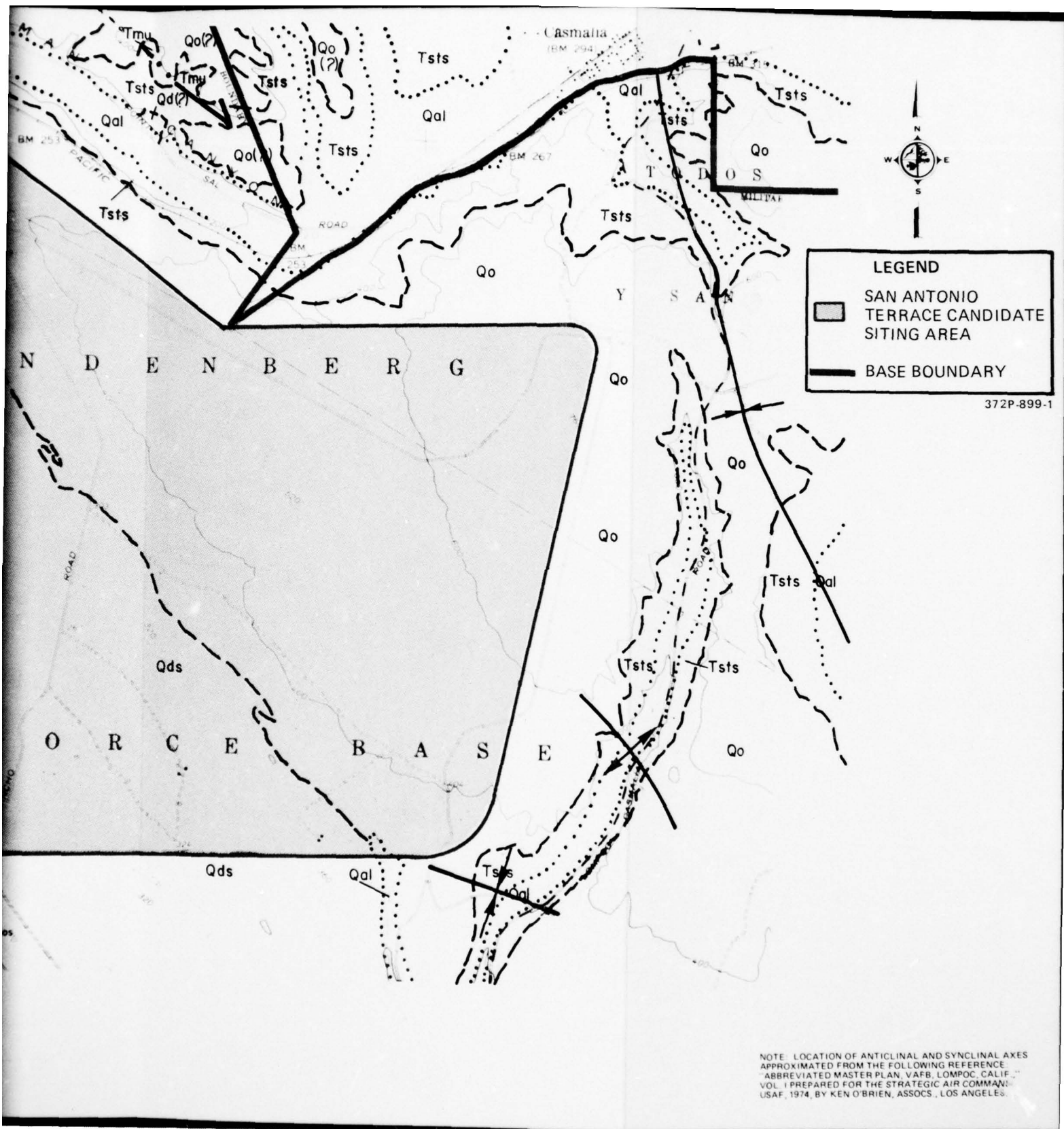
San Antonio Terrace Candidate Siting Area (1.2.3.2).

- Geomorphology. The San Antonio Terrace CSA is located immediately south of Shuman Canon and to the north of San Antonio Creek. Elevations range from under 200 ft (61 m) to greater than 760 ft (232 m). The site is crossed by many low, northwesterly trending, stabilized sand hills, and several low lying areas. The eastern portion of the area is relatively flat and free of dunes.

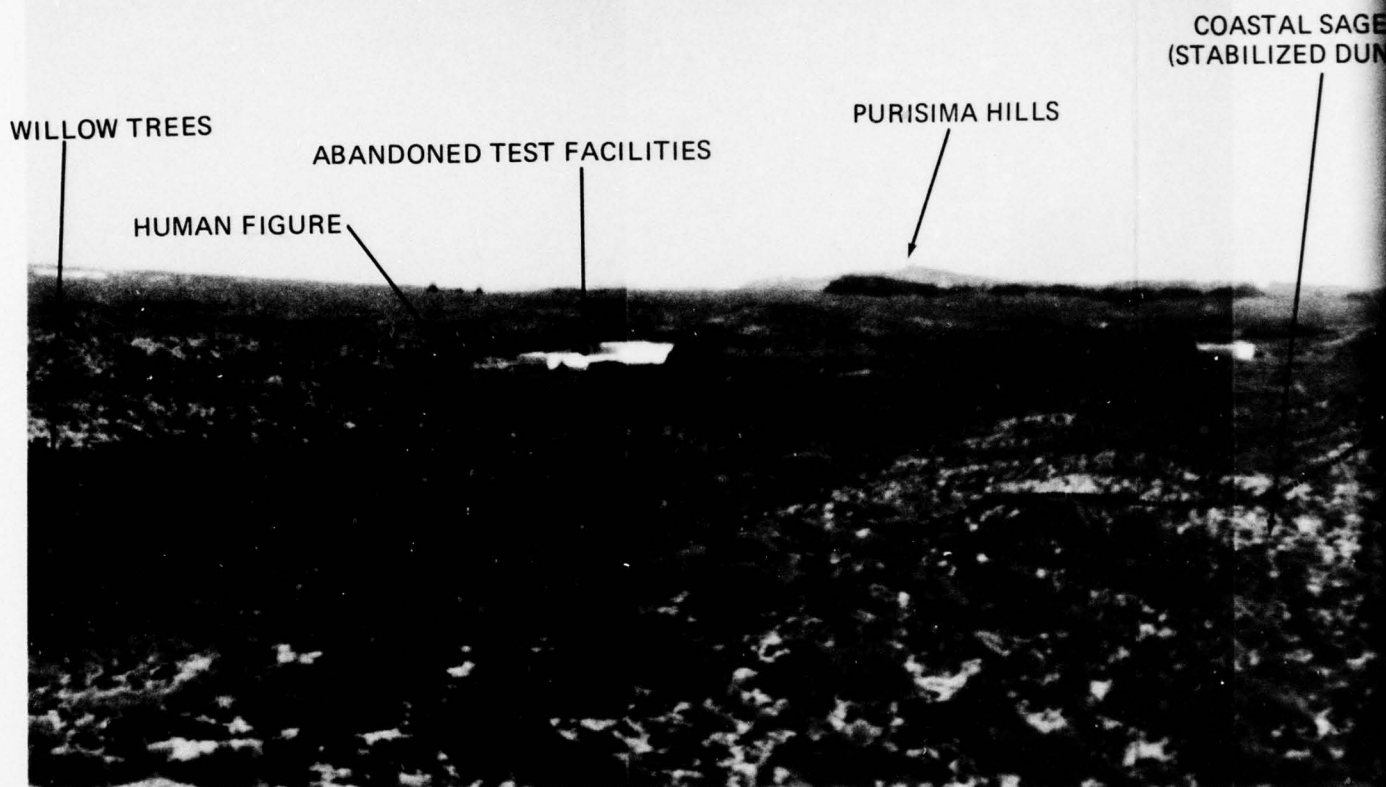
San Antonio Terrace was raised by gentle regional folding of the underlying bedrock deposits (Dibblee, 1950). These deposits were subsequently smoothed by a wave cut platform, and overlain by marine terrace deposits. Subsequently, dune sands were blown over the terrace and were stabilized by vegetation.
- Geology and Seismicity. Surface geology at the San Antonio Terrace CSA consists of Quaternary dune sand and Quaternary terrace deposits (Figure 1-40). The dune sand is clean, mostly fine- to medium-grained sand. Sparse vegetation has mostly stabilized the sand which varies in thickness from 0 to 50 ft (0 to 15 m). No appreciable soil has developed on the sand whose surface is stabilized by root networks. The dune sand rests on terrace deposits, known as the Orcutt Formation, consisting of silty fine-grained sand with traces of clay and limonite concretions (Shipman, 1972). The thickness of the Orcutt probably does not exceed 50 ft (15 m). The terrace deposits are underlain by mudstones and shales probably belonging to the Foxen and Sisquoc Formations. No fault structures are known to underlie this candidate siting area.







EAST



The southwestern half of the San Antonio Terrace Candidate Siting Area is covered by stabilized sand dunes aligned by the prevailing winds to produce ridgelines alternating with swales up to 40 ft deep. The chaparral vegetation which stabilizes the dune formation contains many endemic plant species, including candidate endangered or threatened species. Because of the rugged terrain and special interest vegetation of these dunes, this portion of the candidate siting area is avoided in the conceptual layout of facilities contained in this report.

SOUTH-SOUTHEAST

COASTAL SAGE SCRUB
(STABILIZED DUNE PHASE)

A 40-FOOT DEEP SWALE BETWEEN TWO
RIDGELINES CONTAINING RIPARIAN VEGETATION

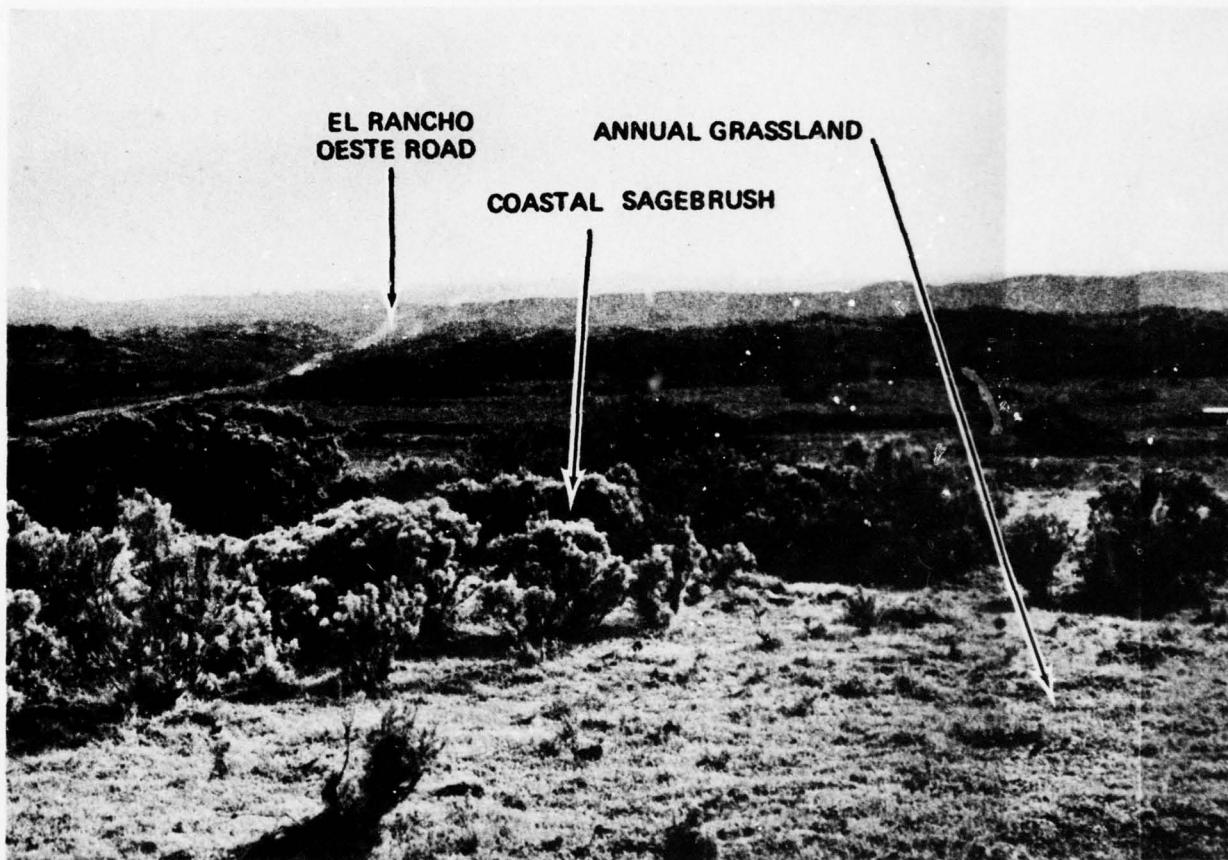
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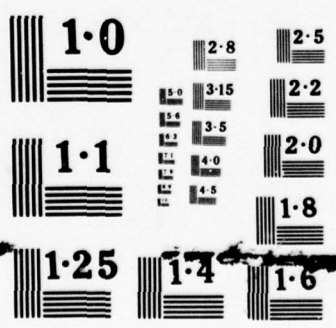
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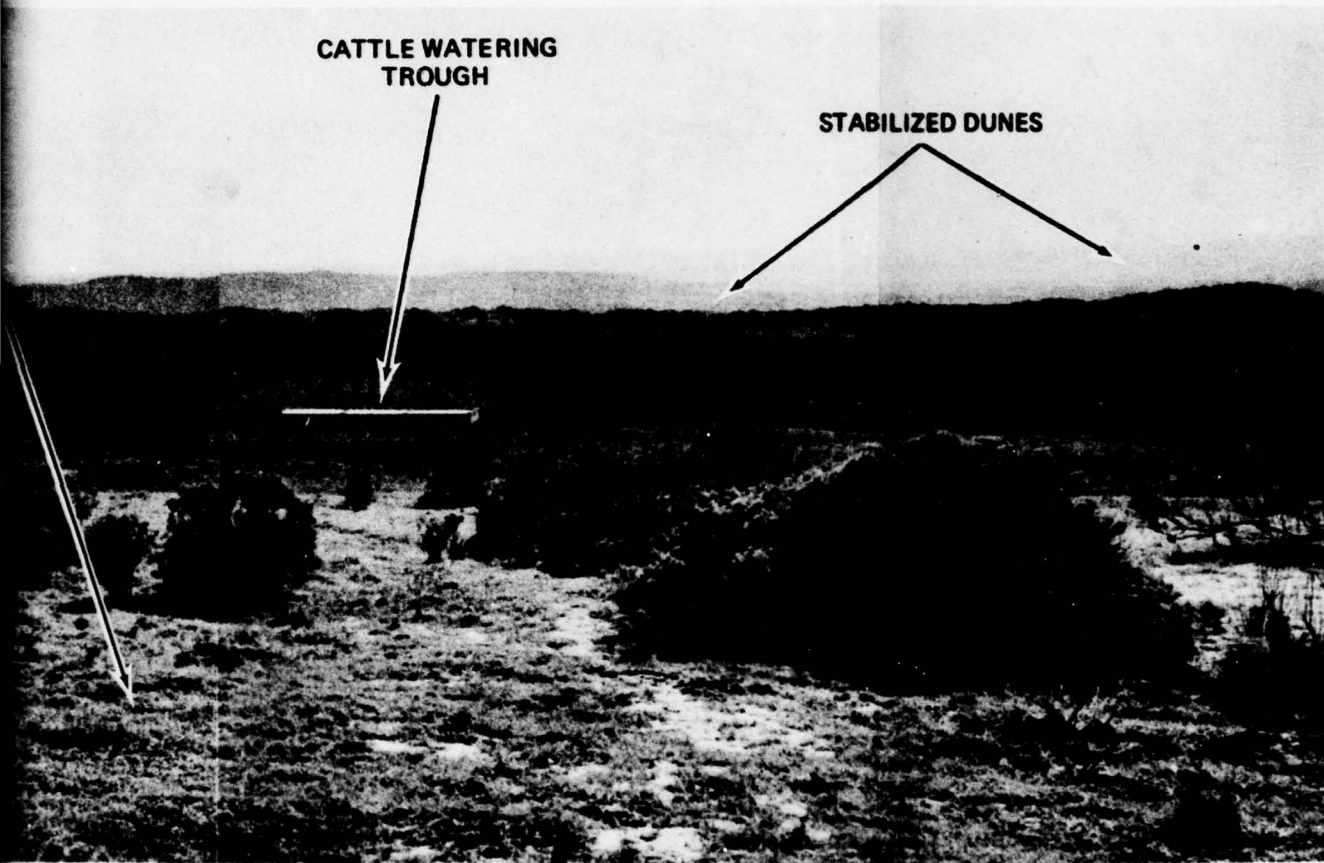
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SOUTHWEST



This half of the San Antonio Terrace Candidate Siting Area is gently sloping even terrain covered with disturbed annual grassland and scattered shrubs. It is in this northeastern portion that the launch facilities are conceptually sited. This portion was selected primarily to avoid the rugged terrain and special interest vegetation of the stabilized dunes. The dunes are visible in the background of this panorama.

The San Antonio Terrace CSA would be subject to severe seismic hazards including ground shaking and liquefaction, but would not be subject to surface faulting and tsunami inundation. It is located one mi (1.6 km) south of the Lions Head fault and about 10 mi (16 km) southeast of the mapped Hosgri fault. Relatively severe ground shaking (Figure 1-19) will occur in the event of a moderate to large earthquake on either of these faults. The potential for soil liquefaction is great locally because shallow groundwater is often perched on the underlying clay and siltstone resulting in the saturation of the overlying unconsolidated Orcutt and dune sands.

- Mineral Resources. Two small abandoned gravel pits exist southeast of San Antonio Terrace CSA near the intersection of San Antonio and Lompoc-Casmalia Roads. No other mining activities exist within or near this candidate siting area. Oil exploration on the terrace located the Jesus Maria Oil Field north of the golf course (Marshallia Ranch). The field was not brought into full production, and the wells were capped in 1958. Union Oil of California may elect to open the field again in 1979 when the "Temporary Release of Rights of Surface Entry" agreement with Vandenberg AFB terminates. Such a reopening could place constraints on VAFB MX activity on San Antonio Terrace and possibly on Shuman Canyon and Burton Mesa as well.
- Paleontology. Foraminifera, gastropods, pelecypods, etc., can be encountered in the Sisquoc and Foxen Formations and the marine terrace deposits. The yield within these formations is low. No collecting localities have been identified within or near the San Antonio Terrace CSA.
- Soils. San Antonio Terrace soils are formed on terrace deposits and to some degree on stabilized dune sands. The terrace soils consist of the silty fine-grained sands of the Orcutt Formation.

The dune sands have no appreciable soil development on them but sparse vegetation has stabilized the dune sands. Engineering properties, as inferred from borings and field observations, indicate that the Orcutt is only slightly compressible and will accept light to moderate loads. The dune sand is more compressible, loose to medium dense, and will not support moderate to heavy loads with normal shallow footings.
- Hydrology. The San Antonio Terrace is located north of San Antonio Creek and south of Shuman Canyon Creek at an elevation of approximately 200 to 400 ft (61 to 122 m). No defined

drainage channels are shown within this siting area on 1:24,000 scale maps or were located during a field reconnaissance of this area.

South of the San Antonio Terrace CSA, a small unnamed creek discharges to Mod III Lake. This lake lies just north of San Antonio Creek. The lake has an estimated storage of 50 acre-ft ($62,000 \text{ m}^3$) with an average depth of approximately 5 ft (1.5 m) and a surface area of 9.6 acres (3.8 ha) (Coulombe and Cooper, 1976). The main branch of San Antonio Creek is approximately 28 mi (45 km) long and drains about 154 mi^2 (400 km^2). A stream flow gaging station is located on San Antonio Creek approximately 3 mi (5 km) upstream from the San Antonio Terrace CSA. Historic stream flow records show a maximum flow of 2,300 cfs ($65 \text{ m}^3/\text{sec}$); this occurred on February 4, 1969 (U.S. Geological Survey, 1976). The estimated average daily flow is approximately 5 cfs ($0.14 \text{ m}^3/\text{sec}$) and the estimated minimum daily flow is approximately 0.1 cfs ($0.003 \text{ m}^3/\text{sec}$). The estimated 10-year, 7-day low flow is 0.3 cfs ($0.008 \text{ m}^3/\text{sec}$).

- Groundwater Hydrology. The San Antonio Terrace CSA is underlain by the nonwater-bearing Monterey shale. Borings and outcrops on the terrace reveal that Monterey units are covered by a claystone unit, a thin unconsolidated deposit of Orcutt sand, and by Holocene dune sand. Perched water is known to occur in the unconsolidated deposits in the San Antonio Valley (Muir, 1964). Due to the impermeable units underlying the more permeable unconsolidated surface deposits, ponding of water and flooding occurs locally during periods of high-intensity rainfall. Groundwater flow would generally be from the terrace north to Shuman Canyon Creek, west to the Pacific Ocean and/or south into the San Antonio Valley.

In the Alluvial aquifer in the San Antonio Valley south of the site, the water table occurs at an approximate elevation of 10 to 30 ft (3 to 9 m) (MSL) (Muir, 1964). The unconsolidated deposits which fill the bottom of the San Antonio Valley are river channel and alluvial deposits of Holocene age, underlain by the Paso Robles Formation (a sand, silt and clay deposit of Pliocene and Pleistocene age) and the Careaga sand. The primary aquifer in the valley is in Holocene deposits; water is also produced from the underlying Paso Robles Formation. As of 1964, the piezometric surface at the west end of the San Antonio Valley was high enough to preclude salt water encroachment.

- Archaeology. Only the northernmost portion of this area has been surveyed and site density was found to be very high. A total of nine limited activity sites and two multiple activity sites are presently known from this CSA, and all but two of these sites are located along the south side of Shuman Canyon. The environmental setting of the unsurveyed portions of this CSA leads to a prediction that archaeological sensitivity there should fall in the low-to-moderate range.
- Terrestrial Biology. The San Antonio Terrace CSA is located within and adjacent to the largest expanse of stabilized sand dunes on the base. The distribution of the stabilized sand dune vegetation is shown in Figure 1-41.

From the coast running inland exists a continuum beginning with beach sand and new, active, unvegetated dunes, and a narrow zone of dunes being stabilized by widespread, commonly prostrate and viney, strand plants (see discussion of Shuman Canyon CSA above). Behind the immediate coast and the dunes being stabilized by strand plants is a broader zone of dunes covered with what Coulombe and Cooper (1976) term the "stabilized dune phase" of coastal sage scrub. This is a vegetation composed of both shrubby and herbaceous elements and in general aspect brings to mind a desert scrub rich in species. The most conspicuous plant here is dune lupine (*Lupinus chamissonis*), a silvery silky-leaved large shrub. Mock heather (*Haplopappus ericoides*), seacliff buckwheat (*Eriogonum parvifolium*), cudweed-aster (*Corethrogyne filaginifolia* vars. *latifolia* and *robusta*), the fragrant *Monardella crispera*, and a live-forever (*Dudleya caespitosa* or *farinosa*) are common associates. Between the 20 to 50 ft (6 to 15 m) tall dunes are low areas (swales) with groundwater seasonally at the surface. These areas support a subset of species from the riparian woodland of Coulombe and Cooper (1976). Conspicuous here are willows (*Salix* spp.); poison oak (*Toxicodendron diversilobum*); a cinquefoil (*Horkelia cureata* subsp. *cuneata*); wild blackberry (*Rubus ursinus*); Hottentot fig (*Carpobrotus edulis*); rosilla (*Helenium puberulum*); coyote bush (*Baccharis pilularis*); and giant creek nettle (*Urtica holosericea*).

Farther inland the stabilized dunes continue to an elevation of at least 600 ft (185 m). Here the dunes are covered with chaparral vegetation containing a few elements of coastal sage scrub. Conspicuous plants here are Lompoc manzanita (*Arctostaphylos viridissima*), interior live oak (*Quercus wislizenii* var. *frutescens*),

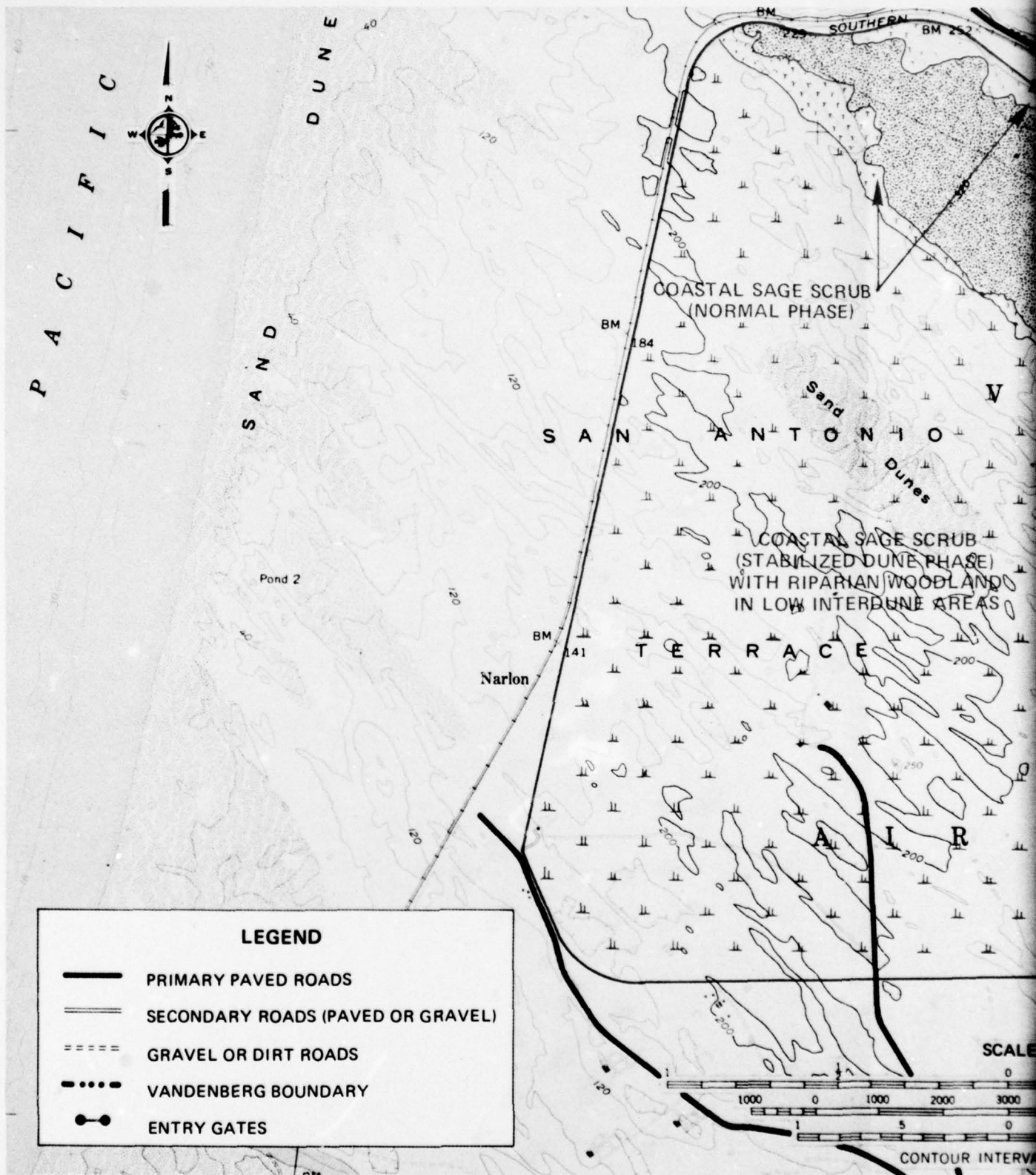
sticky monkeyflower (*Diplacus aurantiacus*), mock heather (*Haplopappus ericoides*), black sage (*Salvia mellifera*), cudweed-aster (*Corethrogyne filaginifolia*), bracken fern (*Pteridium aquilinum*), and a rush rose (*Helianthemum scoparium*). These shrubs and subshrubs are mostly low-growing and cover most of the dune substratum. Even at this distance from the ocean (ca. 4 nm \approx 6.5 km) exposed shrubs show evidence of wind-trimming by the persistent onshore winds. On favorable slopes occur scattered large shrubs of coast live oak (*Quercus agrifolia*) which are conspicuously wind-trimmed and bear hanging beard-like epiphytic growths of a lichen (*Ramalina reticulata*) commonly called Spanish moss.

At the northwestern edge of this candidate siting area, the stabilized dune vegetation gives way to a highly disturbed annual grassland with scattered individuals of mock heather (*Haplopappus ericoides*) as the dominant shrub. The soil is sandy and the terrain slopes gently. This portion of the area is ecologically the least sensitive due to the disturbed nature of the habitat and the probable absence of special interest plant or animal species dependent on this habitat.

- Aquatic Biology. An unnamed marsh approximately 600 ft by 200 ft (183 m by 61 m) is located on San Antonio Terrace just to the southwest of the location of the conceptual trench layout while Umbra Pond and Mod III Lake are situated on the southern edge of San Antonio Terrace (Figure 3-3). Although the marsh has not been sampled, cattails, rushes, willows, and other aquatic or riparian plants were noted in February 1978. A variety of vertebrates may inhabit or frequent the area, such as snakes, salamanders, and birds.

Umbra Pond is a small, shallow pond of 0.2 acres (720 m²) that averages 1.6 ft (0.5 m) deep. Riparian vegetation includes willows, eucalyptus, and poison oak, and the most notable aquatic macrophytes are duckweed (*Lemna minor*), watercress (*Nasturtium officinale*), fern (*Marsilea* sp.), cattail (*Typha* sp.), and bulrush (*Scirpus* sp.)

Mod III Lake is an impoundment that was formed before 1959 and enlarged in 1962-63. The lake is 23 ft (7 m) deep with a sandy substrate nearshore and undecomposed plant material in deeper waters. Natural inflow comes from a small stream that flows through Umbra Pond, and the water level is maintained during dry periods by pumping water from San Antonio Creek. The aquatic macrophytes present include pondweed (*Potamogeton* sp.),



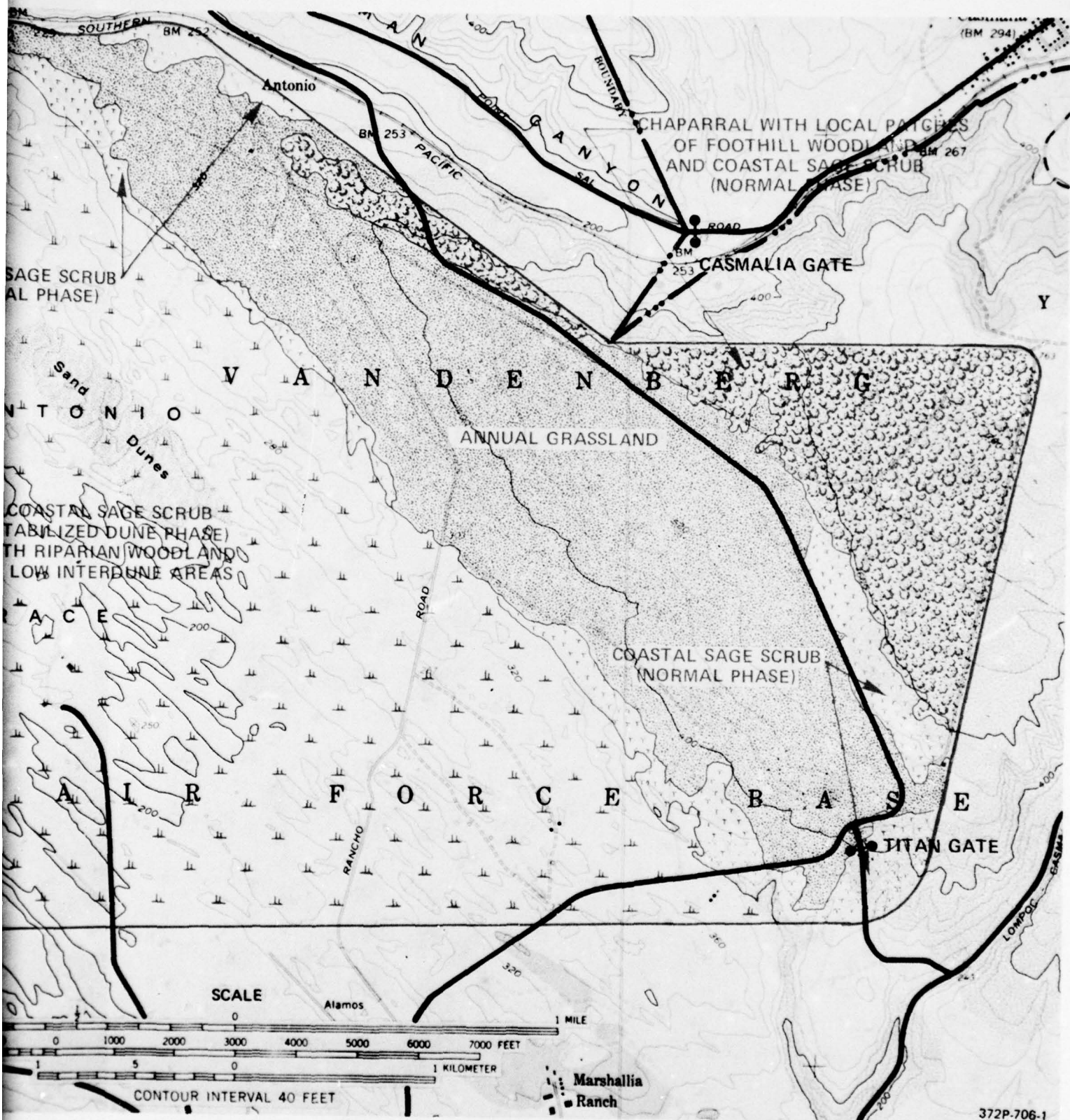


Figure 1-41. Vegetation in the San Antonio Terrace Candidate Siting Area.

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arrowhead (*Sagittaria* sp.) and rushes (*Juncus* sp., *Scirpus californicus*, and *S. robustus*), while euca-lyptus, willow, and several other species characterize the riparian habitat. Algae in the lake include diatoms (*Suriella* sp.), green algae (*Spirogyra* sp.), and eugle-noids (*Colacium* sp.). Benthic invertebrates are dominated by amphipods (*Hyalella azteca*) and chrionomids (fly larvae) although water boatmen (*Corixidae*), mayflies (*Ephemeroptera*), dragonflies (*Odonata*), and molluscs (*Physa* sp. and *Gyrulus* sp.) are also present (Coulombe and Mahrđt, 1976).

Fish are all introduced species and comprise bluegill (*Lepomis macrochirus*), channel catfish (*Ictalurus punctatus*), mosquito fish (*Gambusia affinis*), largemouth bass (*Micropterus salmoides*), and rainbow trout (*Salmo gairdneri*). The trout are stocked annually in winter and spring, and 80 to 90 percent are caught by anglers each year. Frogs, turtles, and snakes probably are present, and the American coot frequents the area.

San Antonio Creek flows between the San Antonio Terrace CSA and the Burton Mesa CSA to the ocean where it forms an estuarine lagoon. Several freshwater marshes are also present along the stream. Numerous riparian and aquatic macrophytes are present with one species of algae (*Enteromorpha* sp.) in the lagoon, and willows offer an overstory toward the lower reaches of the creek. Predominant invertebrates are snails and water boatmen in freshwater and isopods and amphipods in the estuary. The Pacific treefrog (*Hyla regilla*) and other frogs are common and turtles are present. Beaver (*Castor canadensis*) also inhabit the creek, building dams that alter the flow.

Fish in the creek include carp (*Cyprinus carpio*), arroyo chub (*Gila orcutti*), mosquito fish, and the unarmored threespine stickleback which is the only native species (Coulombe and Mahrđt, 1976). Other species that may inhabit the creek are largemouth bass, bluegill, white catfish (*Ictalurus catus*), redear sunfish (*Lepomis microlophus*), and rainbow trout. The stickleback is classified as endangered by the U.S. Fish and Wildlife Service, and this population may be at the northern limit for the species. These fish require weedy areas for breeding and may not reproduce in stagnant waters.

The lagoon at the mouth of the creek varies from one large pool to a series of connected pools. Pondweed and fila-mentous algae occasionally become very dense in the lagoon and creek, and low dissolved oxygen conditions occur when these decompose (CDFG & USFWS, 1976). Western pond turtles (*Clemmys marmorata*), the Pacific staghorn sculpin, and the tidewater goby are also present.

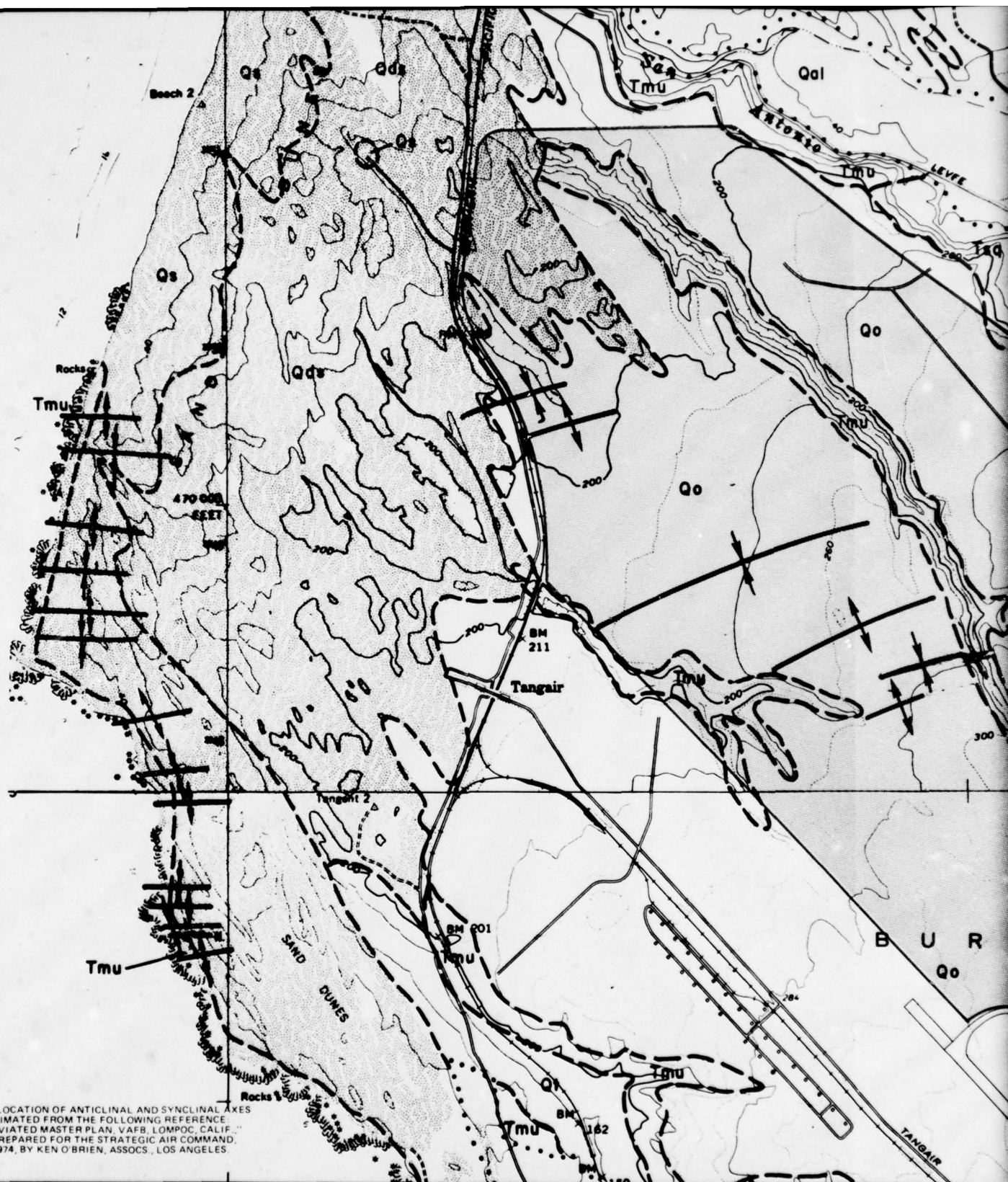
The creek, lagoon, and marshes are frequented by many mammals (e.g., feral pigs, deer, and raccoon) and birds including the least tern which is on the U.S. Fish and Wildlife Service endangered list.

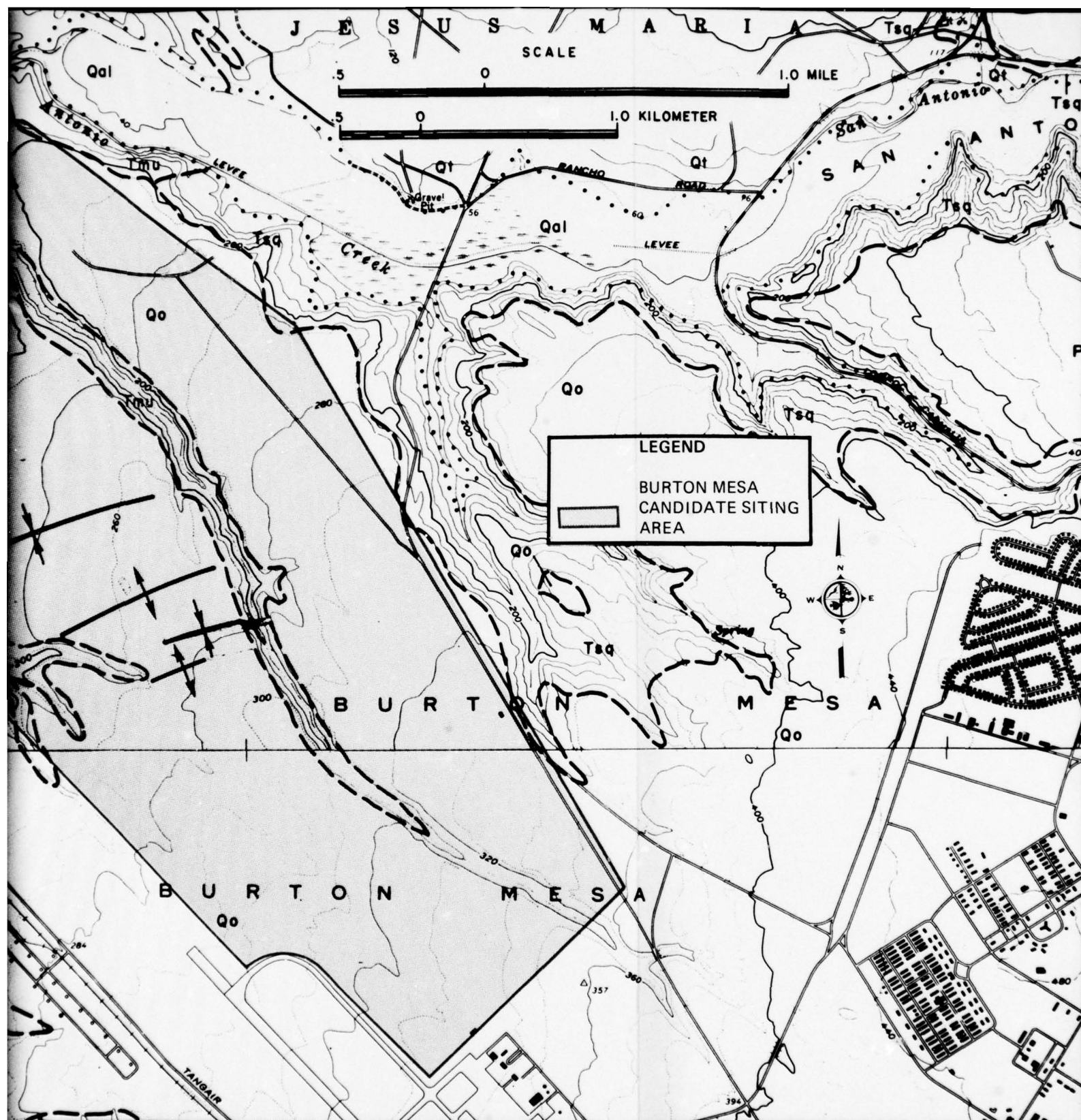
Burton Mesa Candidate Siting Area (1.2.3.3)

- Geomorphology. Burton Mesa CSA is bounded by San Antonio Creek to the north and the Santa Ynez River to the south. The terrain is relatively flat, with elevations ranging from 100 to 350 ft (30 to 105 m). In the extreme north of the area, a drainage forms a large, deep gully trending to the northwest. The mesa is modified by three other intermittent streams trending northwest and exhibiting appreciable erosion. The mesa is founded on gently folded bedrock, which was planed off by wave action and unconformably overlain by marine terrace deposits.
- Geology and Seismicity. The surficial deposits on the Burton Mesa CSA consist of small areas of dune sand and terrace deposits (Figure 1-42). The area is underlain by Monterey shales capped by Orcutt sands as seen in the southern cliffs along San Antonio Creek. The contact of the overlying Sisquoc Formation is found farther east due to the local upwarping of Burton Mesa (Upson and Thomasson, 1951). At Burton Mesa, the underlying structure is broadly anticlinal with complex folds and minor faults that are typical of the Monterey Formation exposed there and elsewhere on the base (Dibblee, 1950).

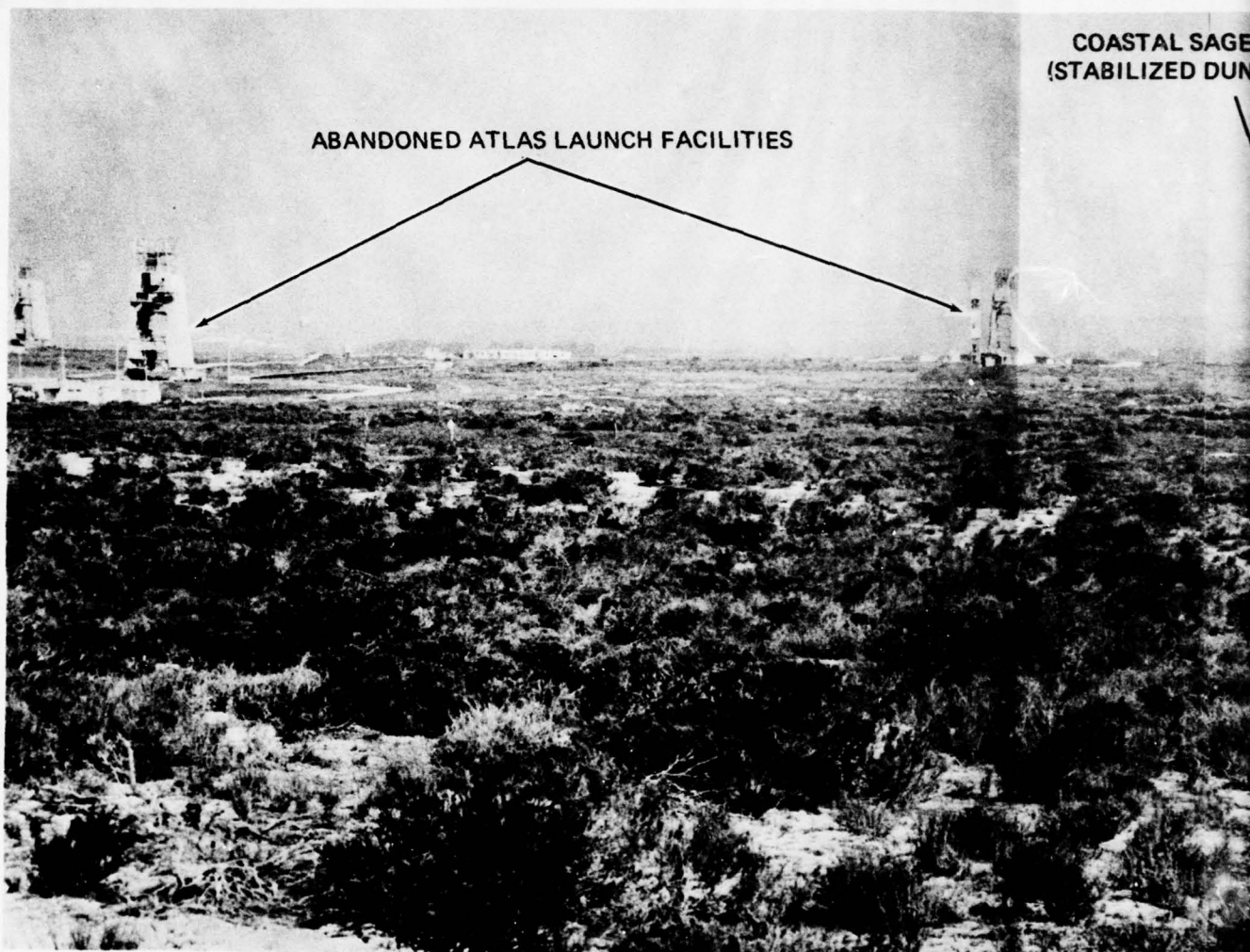
The Burton Mesa CSA would be subject to severe seismic hazards. The potential for landslides should be small because the topographic relief is not pronounced away from the gullies. However, cut slopes could still be subject to failure. Where saturated soils exist, due to perched groundwater or shallow groundwater tables, liquefaction of the Orcutt sand may occur in response to strong seismic activity. Flooding due to inundation by tsunamis is unlikely based on historic records. The Burton Mesa CSA is located on the terrace and is topographically removed from the areas of potential flooding.

- Mineral Resources. Several inactive pits for gravel and diatomite extraction were opened along the south side of Burton Mesa but are not in the Burton Mesa CSA. No other mining activities are near this candidate siting area. Exploratory oil wells were abandoned during the period 1929 to 1953, either because of oil quality or because the search for petroleum proved unsuccessful. The abandoned wells are located near Cañada Tortuga, Oak Canyon and an unnamed adjacent canyon to the west.





NORTH-NORTHEAST



COASTAL SAGE
(STABILIZED DUN)

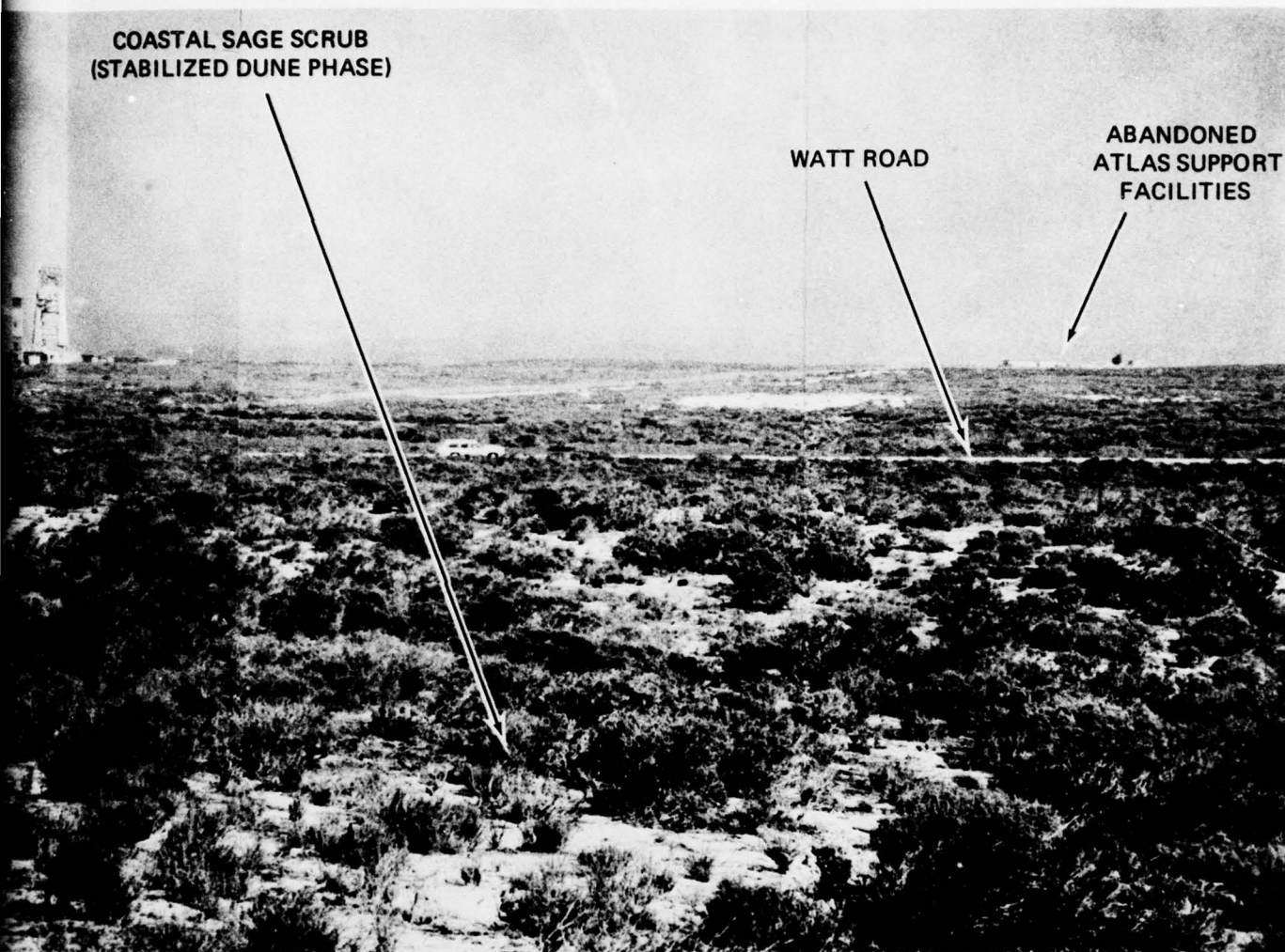
ABANDONED ATLAS LAUNCH FACILITIES

EAST

COASTAL SAGE SCRUB
(STABILIZED DUNE PHASE)

WATT ROAD

ABANDONED
ATLAS SUPPORT
FACILITIES



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The Burton Mesa Candidate Siting Area is nearly flat terrain mostly covered by disturbed annual grassland and low shrubs. In this panoramic view of the northern portion of the siting area, the abandoned Atlas launch facilities dominate the landscape.

- Paleontology. Burton Mesa is overlain by the Orcutt sand, which generally has a low yield of fossils. Middle and Upper Miocene Monterey Formation occur in the canyon south of San Antonio Creek. These contain microscopic foraminifera.
- Soils. Soils on Burton Mesa CSA are developed primarily on the Orcutt Formation. The soils consist of silty fine-grained sands on the Orcutt with some sandy silts. The coastal area west of the railroad consists of Orcutt covered by dune sand.
- Hydrology. The Burton Mesa CSA is located south of San Antonio Creek, and northwest of the main area of Vandenberg. A canyon with a maximum depth of approximately 80 ft (24 m) passes through the site and a small ephemeral stream is located in the canyon. The drainage area of this stream is approximately 3.3 square miles (8.5 km²). A peak flow of 125 cfs (3.5 m³/sec) is estimated for the mean annual flood, while the 100-year flood is estimated to have a peak flow of approximately 5,000 cfs (142 m³/sec) (Young and Cruft, 1967). Other than this canyon area, the Burton Mesa CSA is generally level and most runoff would occur as sheet flow.
- Groundwater Hydrology. The Burton Mesa CSA is hydrogeologically similar to the San Antonio Terrace CSA. It is underlain by the nonwater-bearing Monterey Formation which is overlain by approximately a 25-foot (7.6 m) thick deposit of Holocene sands (Arnold and Anderson, 1907). Perched water is known to occur in the unconsolidated sand deposits because of springs that occur at their outcrop along the San Antonio Valley (Muir, 1964). Any ground water flow from the Burton Mesa site would move north into the San Antonio Valley, west into the Pacific Ocean, south into the Lompoc Valley or east into Oak, Pine or Lake Canyons, which in turn drain into Lompoc Valley. In the alluvial aquifer in the San Antonio Valley north of the Burton Mesa site, the water table occurs at approximately 10 to 30 (3 to 9 m) elevation (MSL) (Muir, 1964); in the alluvial aquifers in the Lompoc Valley south of the siting area, the water table occurs at approximately 10 to 40 feet (3 to 12 m) elevation (MSL) (Upson and Thomasson, 1951). Any perched water encountered on the Burton Mesa CSA would be expected to occur at higher elevations than the water in the valley.
- Archaeology. More than 50 percent of this area has been previously surveyed and four limited activity sites are known to occur here. Based upon its general environment, the unsurveyed portions of this CSA are predicted to be of low-archaeological sensitivity. This prediction

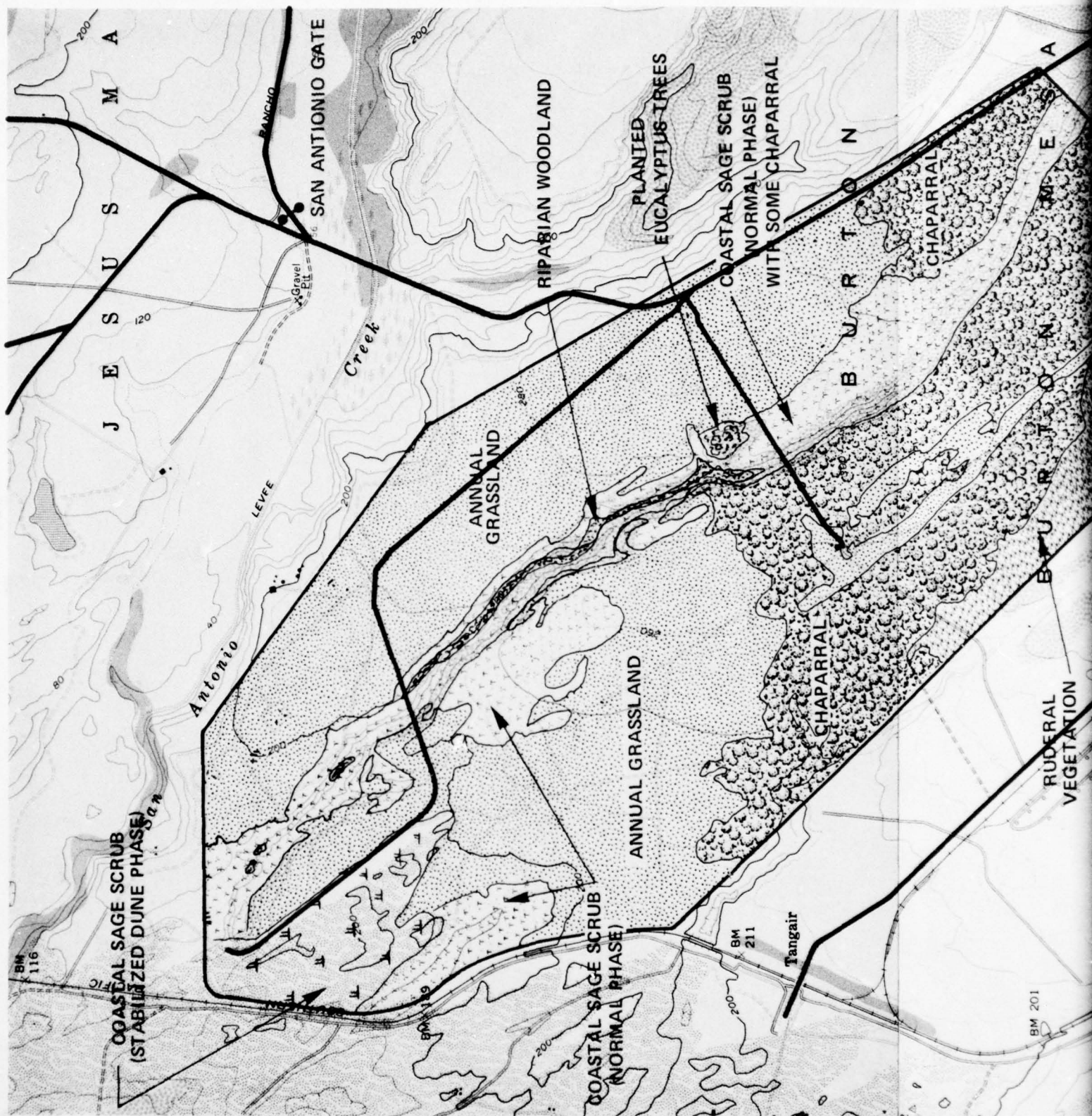
receives some support from the results of Glassow's (1977) survey of a limited area within this CSA when only isolated artifacts are encountered.

- **Terrestrial Biology.** The Burton Mesa CSA contains several distinct vegetation types (Figure 1-43). Extensive portions of the CSA are covered with annual grassland/coastal sage scrub growing on formerly cleared, flat terrain. Riparian vegetation and coastal sage scrub occur in a large canyon, and extensive flat areas on the southern portion of the CSA support a peculiar chaparral. The CSA also contains the stabilized dune phase of coastal sage scrub and a large grove of planted eucalyptus trees (*Eucalyptus globulus*).

The species composition of a representative area of the coastal sage scrub/annual grassland formation typical of the northern part of the Burton Mesa CSA follows: mock heather (*Haplopappus ericoides*), coyote bush (*Baccharis pilularis* subsp. *consangiunea*), coastal sagebrush (*Artemisia californica*) and the weedy sawtooth goldenbush (*Haplopappus squarrosus*) are dominant shrubs. Perennial associates include the prostrate, scruffy-leaved *Croton californicum*, cudweed-aster (*Corethrogyne filaginifolia*), poison oak (*Toxicodendron diversilobum*), deerweed (*Lotus scoparius*), goldenrod (*Solidago spathulata*) and a cinquefoil (*Horkelia cuneata*). The latter two species occur in patches. Here and there occur individuals of chamise (*Adenostema fasciculatum*) typical of chaparral. Between the shrubs is a herbaceous matrix of introduced annual grasses and native and introduced annual grasses and native and introduced annual herbs.

Important species in the chaparral that begins near the junction of Cross Road and Hito Road and near the center of the candidate siting area and continues to the east and south are black sage (*Salvia mellifera*), Lompoc manzanita (*Arctostaphylos viridissima*) shagbark manzanita (*A. rudis*), coast ceanothus (*Ceanothus ramulosus*), Santa Barbara ceanothus (*C. impressus*), a rockrose (*Helianthemum scoparium*), mock heather (*Haplopappus ericoides*) and a cinquefoil (*Horkelia cuneata*). The shrubs commonly support dense growths of epiphytic, shrub-like lichens which obtain their moisture from fogs and sea breezes.

The prostrate form of the shrubs, especially of the manzanitas and the ceanothus may be due as much to the constant sea breeze and nutrient-poor soils as to genetic factors. Mr. Dara Emory (horticulturalist, Santa Barbara Botanical Garden) has grown samples from several of these prostrate species from Vandenberg and the surrounding



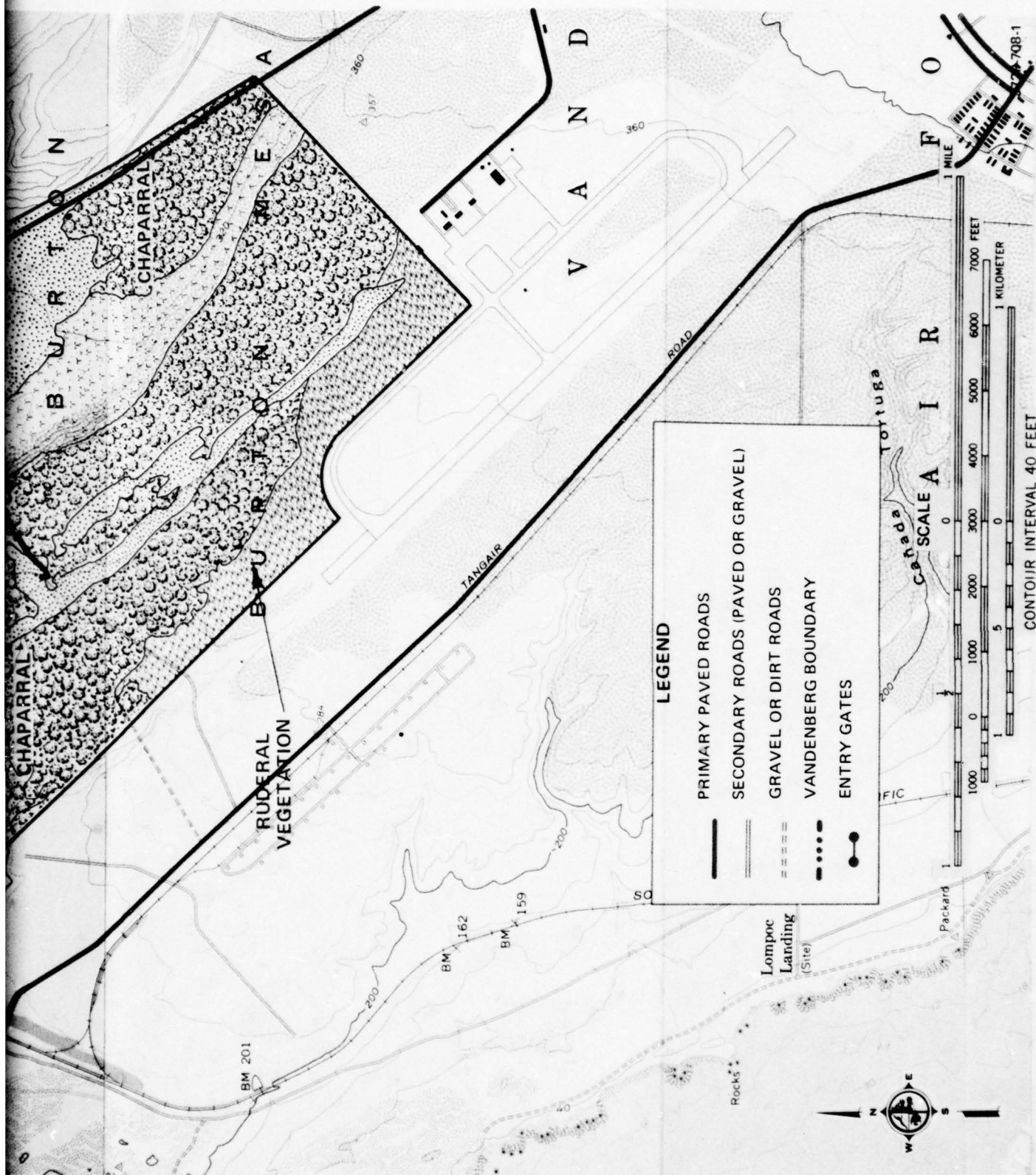


Figure 1-43. Vegetation in the Burton Mesa Candidate Siting Area.

area and he has found: (1) that most samples do not retain their prostrate form in cultivation; and (2) that most do not grow well in "good soils". Evidently they are rather well-adapted to the nutrient-poor, barren soils in which they grow.

The species composition of the sand dunes in the northwestern portion of the Burton Mesa CSA is similar to that of similar sites on the San Antonio Terrace. The conspicuous plants here are mock heather (*Haplopappus ericoides*), dune lupine (*Lupinus chamissonis*), dune mint (*Monardella crispera*) and prickly-phlox (*Leptodactylon californicum*). A peculiar annual chorizanthe (*C. californica* var. *suksdorfii*) occurs here and there in the dunes.

A steep-walled deep canyon, apparently unnamed, runs diagonally from southeast to northwest approximately through the middle of the siting area. It widens until it terminates at the coastal sand dunes near where it probably at one time joined San Antonio Creek just above its mouth. The canyon bottom supports a tangle of riparian vegetation typical of other canyons on Vandenberg. Dominant trees are willows (*Salix* spp.) with a number of mesophytic herbs and subshrubs forming an understory. This area is an important habitat for wildlife, and scat of deer, skunk and small mammals abound. The rather steep-walled sides of the canyon support dense coastal sage scrub/chaparral vegetation with patches of sea dahlia (*Coreopsis gigantea*), a semisucculent coastal native plant.

- Aquatic Biology. The only water body in the Burton Mesa CSA is an unnamed pond located in the northwest end of the deep arroyo that traverses the mesa. The invertebrate fauna would be expected to be similar to that in Mod III Lake, and it is not likely that any fish other than mosquito fish are present.

Lompoc Terrace Candidate Siting Area (1.2.3.4)

- Geomorphology. Lompoc Terrace CSA is located on a gently inclined surface facing northwest from the foot of the Santa Ynez Range. Elevations range from 100 to 500 feet (30 to 150 m). The Lompoc Terrace CSA is bounded to the east by Lompoc Canyon and to the south by Bear Creek and is not crossed by any drainages.
- Geology and Seismicity. The Lompoc Terrace CSA consists of the Orcutt sand and Quaternary terrace and dune deposits. It is situated in a down-faulted area that has protected much of the Sisquoc and Careaga Formations

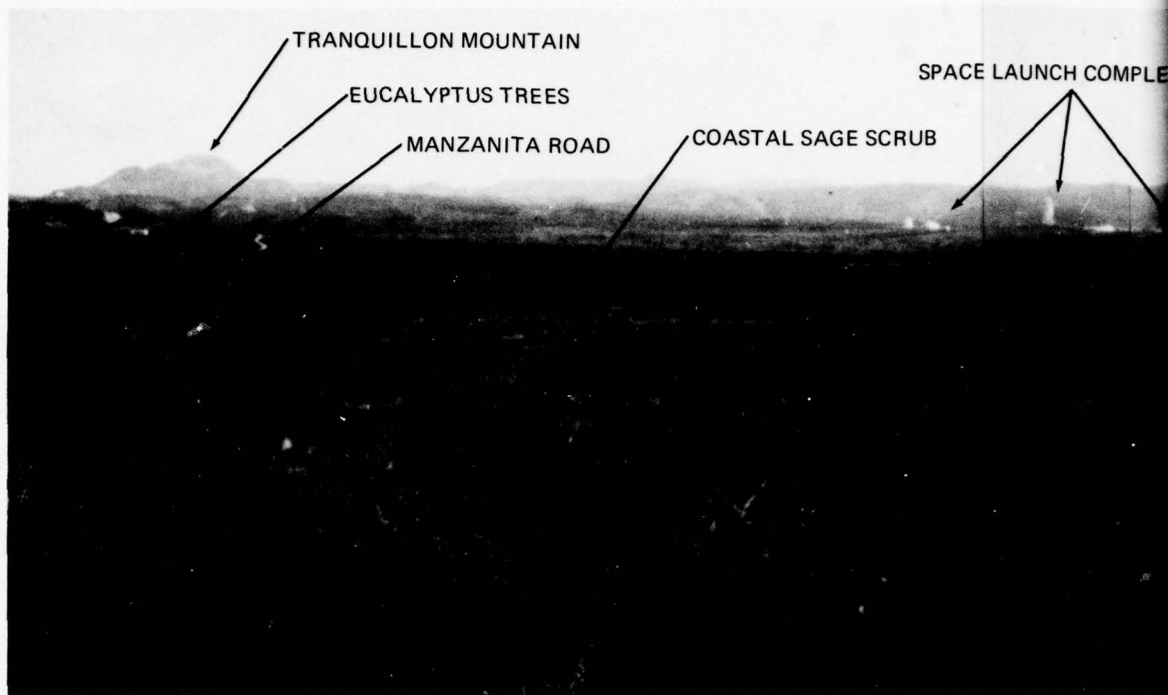
underlying the site from erosion (Figure 1-44) (Evenson and Miller, 1963). The Sisquoc and Careaga are in turn overlain by older dune sand and Orcutt sand whose cumulative thickness is as much as 100 feet at the site.

North of the Honda fault, the two faults shown on Lompoc Terrace have been identified from test wells and field inspection (Figure 1-43). They bound a graben structure with the greatest displacement on the south side. Evenson and Miller (1963) indicate that the southern fault plane is south-dropping the northern block. The northern fault is only inferred, and it may be the result of a sharp fold in the Tertiary rocks rather than faulting (Evenson and Miller, 1963). A strong topographic contrast in the Quaternary age sands across the southern fault suggest that it has experienced Quaternary displacement. Stream profiles (thalweg profiles) of Bear Creek and Lompoc Canyon show steepening of the streams across the southern fault and may indicate Holocene displacement.

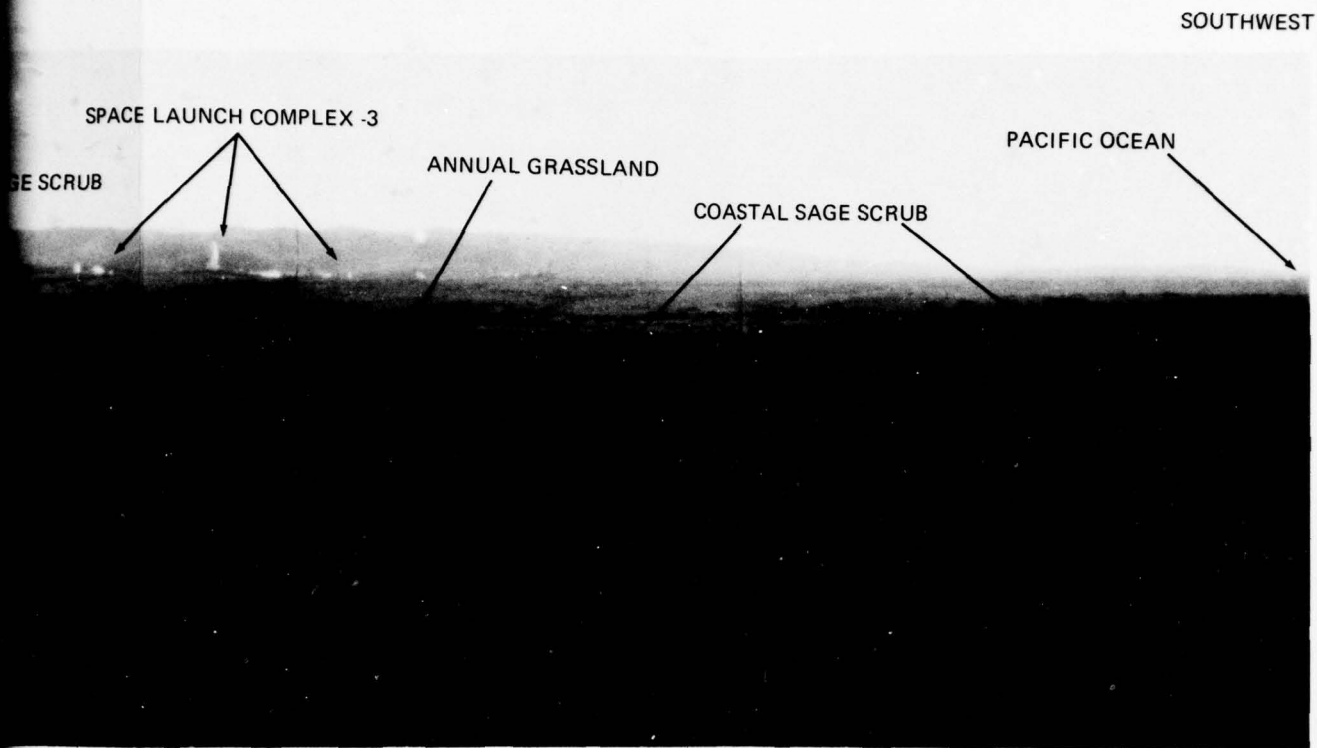
This candidate siting area is subject to severe ground shaking, surface faulting and cut slope failures. The potential for cut slope failures exists because loose materials are present, but natural landslide failures are not likely. Existing water wells on Lompoc Terrace suggest a depth to the ground water table below 100 ft (9 m) below the surface. Liquefaction of materials at that depth is unlikely. Flooding due to peak storm runoff is not likely based on historic records and the presence of two well defined drainages bounding the candidate siting area. Due to the topographic relief and distance from the coastline, tsunami inundation will not be a hazard.

- Mineral Resources. The Lompoc Terrace CSA is near, but not coincident with, small scale, inactive open pit mining operations for gravel and diatomite. Oil exploration started on the terrace in 1907 and ended in 1955 without success. Seven test wells were drilled and abandoned south of Bear Creek Road. One test well was drilled on the terrace east of Surf and was abandoned. These tests suggest that the area is not promising for future oil exploration.
- Paleontology. The surface of Lompoc Terrace is covered with Orcutt sand, and is underlain by the Careaga and Monterey Formations. The Careaga Formation has yielded the widest variety of fossils, but these were found at only two locations, neither of which is on or near the candidate siting area. The Monterey Formation has yielded a few foraminifera and pelecypods, and the Orcutt sand has yielded a few mollusks and ostracods, but no collecting localities are known within the Lompoc Terrace CSA.

SOUTH

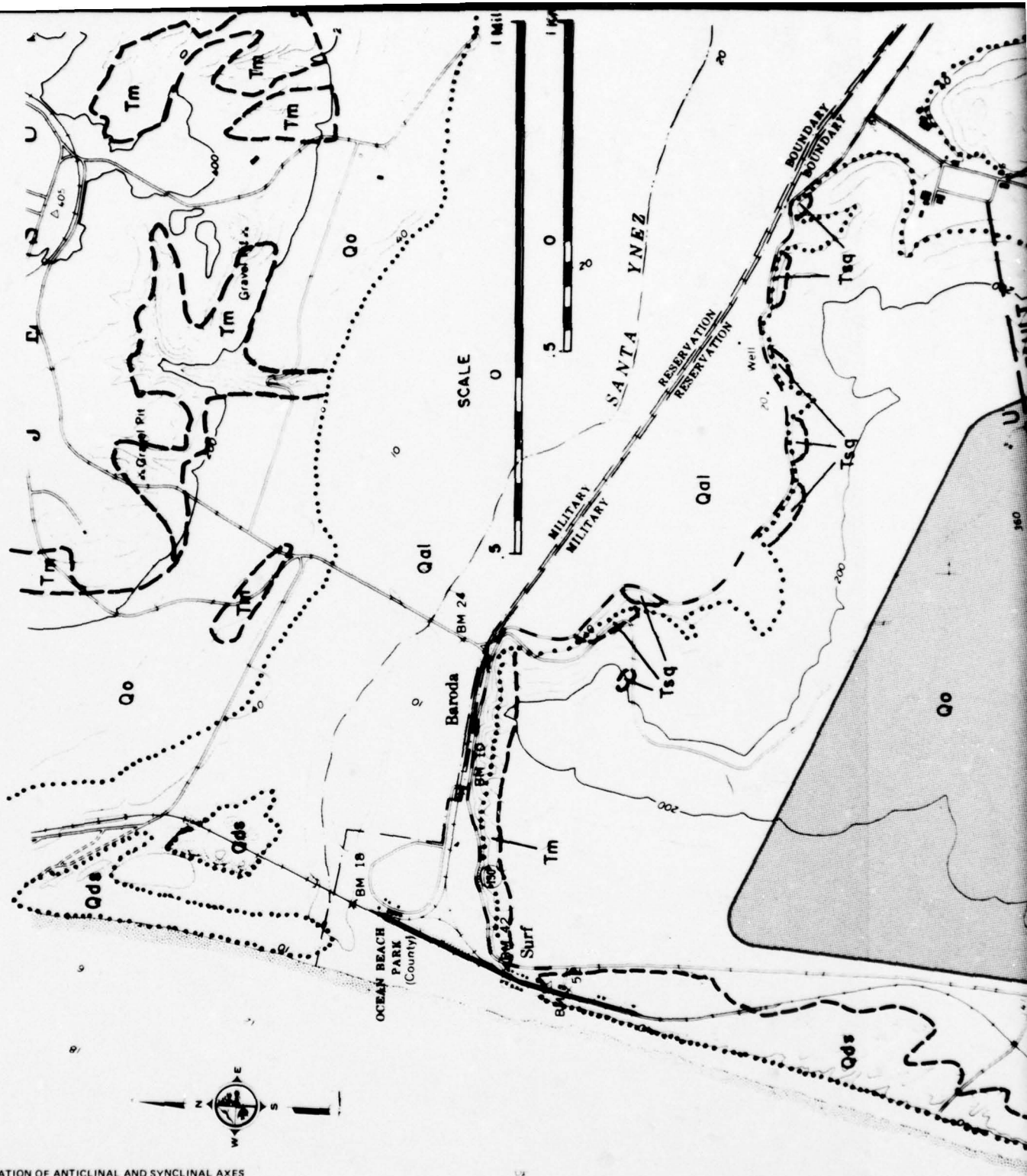


The Lompoc Terrace Candidate Siting Area has gently rolling terrain with some slopes in excess of 10 percent. In this panorama, Tranquillon Mountain is visible on the horizon to the south. The SLC-3 launch facilities can be seen in the center of the picture.

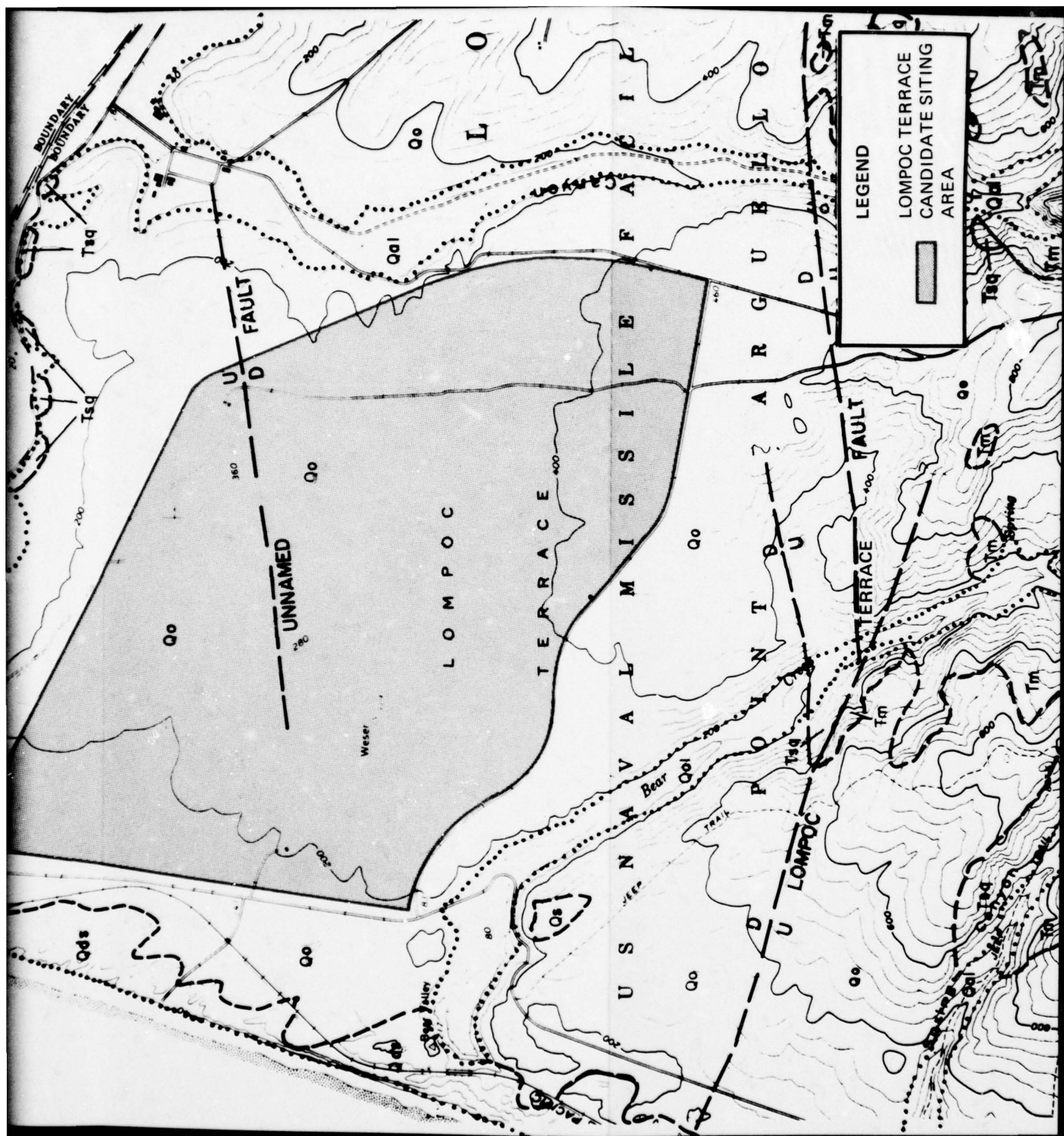


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NOTE: LOCATION OF ANTICLINAL AND SYNCLINAL AXES
 APPROXIMATED FROM THE FOLLOWING REFERENCE:
 "ABBREVIATED MASTER PLAN, VAFB, LOMPOC, CALIF."
 VOL. I PREPARED FOR THE STRATEGIC AIR COMMAND,
 USAF, 1974, BY KEN O'BRIEN, ASSOCS., LOS ANGELES.



- Soils. The Orcutt Formation and dune sands near the coast are at the surface of the Lompoc Terrace CSA. The soils developed on the Orcutt are silty sands and sandy silts.
- Hydrology. The Lompoc Terrace CSA is located on Lompoc Terrace south of the Santa Ynez River. The elevation ranges from approximately 200 to 1,400 ft (61 to 427 m) (MSL). There are no defined drainage channels crossing the candidate siting area.

The Santa Ynez River has a drainage area of approximately 900 square mi (2,330 km²), making it the largest of the drainages traversing Vandenberg. In the general vicinity of the Lompoc Terrace CSA, a broad flat flood plain, reaching a maximum width of over 2 mi (3.2 km), characterizes the Santa Ynez River Valley. The flow of the river is controlled by storage in the upper reaches of the watershed. Appropriation of the river's flow by various water users also affects the discharge in this section of the river. Moreover, during certain periods of the year, flow may cease. The estimated average daily discharge is approximately 51.5 cfs (1.46 m³/sec). The peak recorded runoff from the Santa Ynez basin was measured as 100,000 cfs (2,830 m³/sec), in January 1969. The flow from the river discharges into a long narrow lagoon approximately 1 mi (1.6 km) inland from the Pacific Ocean. The delineated flood plain of the Santa Ynez River in the area is shown in Figure 1-45. The 100-year flood level does not impinge upon any portion of the candidate siting area.

To the east of Lompoc Terrace is a north-south oriented canyon known as Lompoc Canyon. A small ephemeral stream, draining portions of Lompoc Terrace, flows through this canyon. The south side of Lompoc Terrace is bordered by Bear Creek, a small ephemeral stream which flows westerly to the Pacific Ocean.

- Groundwater Hydrology. The Lompoc Terrace CSA is underlain by a thick sequence of the Careaga sand that has been deposited in what is probably a graben. The Careaga sand is overlain by up to 300 ft (90 m) of Orcutt sand. Groundwater primarily occurs in three zones: two zones in the lower member (Cebada) of the Careaga sand and one zone in the top of the upper member (Graciosan) of the Careaga sand and bottom of the Orcutt sand. Most of the Orcutt sand is above the water table but some perched water does occur in it (Evenson and Miller, 1963).

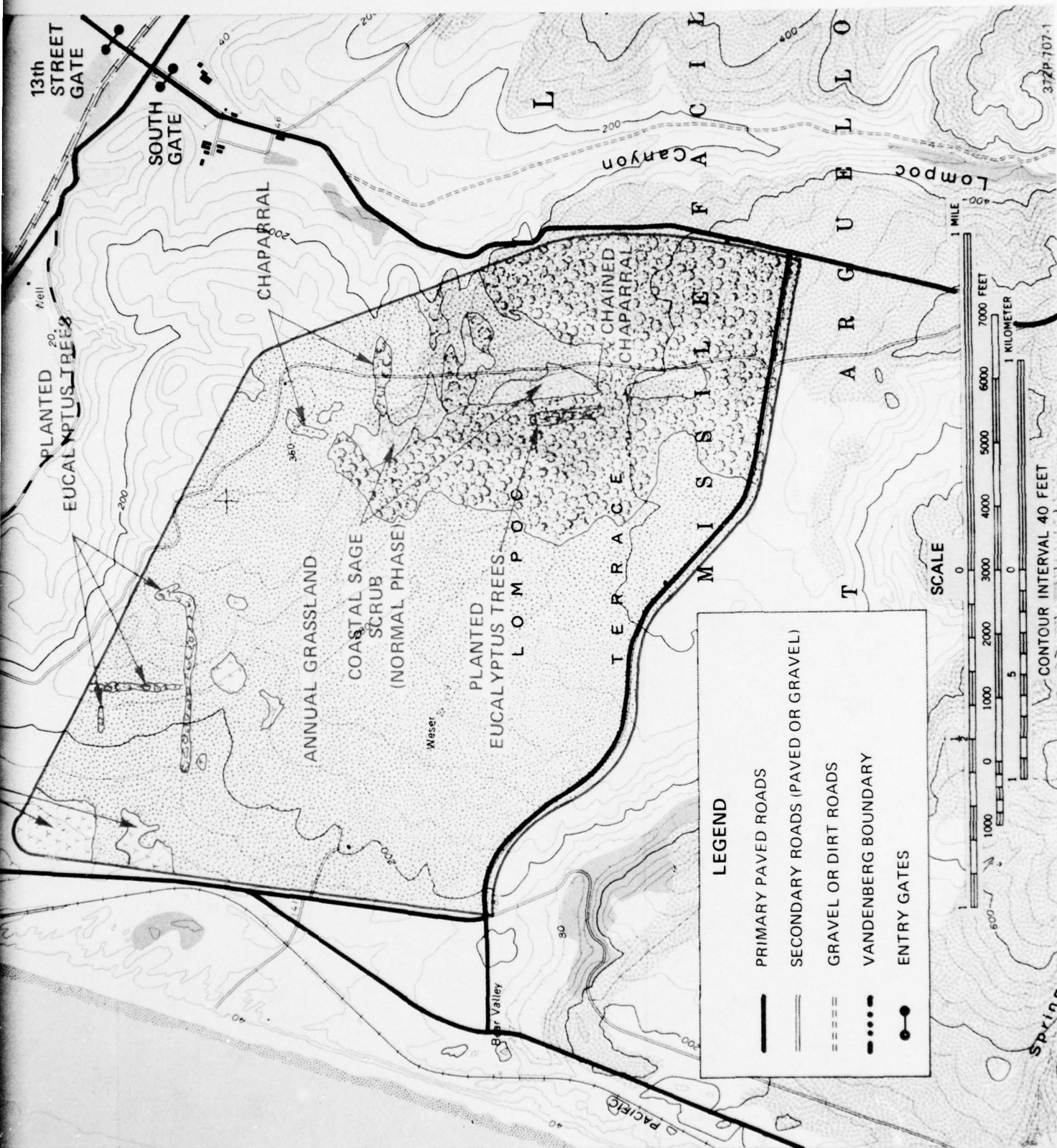
Presently Vandenberg is pumping water from the Lompoc Terrace from two wells at the combined rate of 230 acre-ft/year ($0.3 \times 10^6 \text{ m}^3$). Evenson and Miller (1963) estimated that the available storage of groundwater in the Lompoc Terrace is 60,000 acre-ft ($74 \times 10^6 \text{ m}^3$) and that the Lompoc Terrace aquifers could sustain a pumping rate of no more than 500 gallons (2 m^3) per minute. Under present conditions, much of the groundwater recharging to the Lompoc Terrace eventually discharges into the aquifers in the Lompoc Valley to the north. As of 1963, the piezometric level in the western end of the Lompoc Valley had not been reduced to a level where salt water intrusion could occur. No measurements have been made since 1963 to monitor piezometric level variation.

- Archaeology. This area has been surveyed and three limited activity sites are known to occur here. To both the north and the southwest of this CSA, site density is very high and the archaeological sensitivity of those areas is very high and moderate to high, respectively.
- Terrestrial Biology. The Lompoc Terrace CSA is relatively level to gently rolling country vegetated primarily by a mock heather (*Haplopappus ericoides*) dominated vegetation transitional between coastal sage scrub and annual grassland. Weedy shrubs and subshrubs at varying densities form an overstory to an introduced annual grassland matrix. Figure 1-45 indicates the vegetation types found within this candidate siting area.

At the inland limits of the area near Lompoc Canyon, the vegetation grades into chaparral on slopes that are somewhat protected from the strong sea breezes and have an easterly or northeasterly exposure. In a restricted area, Bishop pine (*Pinus muricata*) occur growing in chaparral on gentle to rather steep slopes leading into Lompoc Canyon and having the form of large shrubs. Bishop pine is a fire-adapted, closed-coned species. After a fire, the cones on the dead standing adults open and release the seeds which germinate readily on the bare mineral soils exposed by the fire. The few stands of Bishop pine in this area are relicts of wetter Pleistocene times and their main distribution at present is well north of Vandenberg.

Farther inland on the Lompoc Terrace CSA a well-developed coastal sage scrub/chaparral mixture occurs. Here, chaparral and well-developed coastal sage scrub do not exist as distinct entities, but tend to grade into one another. The differences between the two types lie in the proportion of very woody, evergreen leathery leaved





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Figure 1-45. Vegetation in Lompoc Terrace Candidate Siting Area.

shrubs (e.g., manzanita, ceanothus, scrub oak, chamise) to less woody, mostly drought-deciduous soft-leaved (malacophyllous) shrubs (e.g., coastal sagebrush, mock heather, black sage), with chaparral characterized by a high proportion of the former type and vice-versa. Brush control measures such as chaining used to open up this vegetation and to encourage herbaceous growth have been employed in this area. These control measures are at least partially responsible for the prominence of herbaceous and soft-woody species in patches alternating with dense, woody chaparral.

Near the coast is an area of coastal sage scrub stabilized dune phase which grades into the coastal sage scrub annual grassland. The low stabilized dunes here are dominated by mock heather, with deerweed, *Corethrogyne*, *Croton*, coastal sagebrush and sea fig (*Carpobrotus aequilaterus*). This type is better represented elsewhere on the base, particularly on San Antonio Terrace.

The influence of the strong sea breeze is especially noticeable in the planted windbreaks of *Eucalyptus* where the sea-facing individuals are notably stunted and the collective canopy tapers from a low point on the sea-facing side to a high point on the lee side. Saplings and seedlings of these trees occur in their lee. Here, as elsewhere in the vicinity (especially evident on Burton Mesa near the cantonment) native shrubs are much larger on the lee side of these groves than they are in more exposed situations.

- Aquatic Biology. The Lompoc Terrace CSA is bounded on the north by the Santa Ynez River and Lagoon and on the south by Bear Creek (an intermittent stream). Much of the Santa Ynez River is dry during the summer although flows may occur underground. High flows and flooding can occur during the winter months.



Land Use

2

RELATIONSHIP OF PROPOSED ACTION TO LAND USE PLANS, POLICIES, AND CONTROLS FOR THE AFFECTED AREA

Expanded activities associated with MX facilities construction and operation will be felt at three specific levels:

- On the Base itself where construction and related activities will occur.
- In the Base Environs where employees reside and where resources are acquired.
- In the Region, the remainder of Santa Barbara County, where expenditures of Vandenberg personnel and employees will be concentrated.

This section identifies existing land use and trends in land use in these three areas, including plans, policies, and controls. Anticipated effects of expanded base operations are then overlaid upon the data developed to provide the area's public and decisionmakers with information needed to determine the acceptability of the impacts and the mitigative measures which may be adopted to ensure both environmentally and economically sound project implementation.

2.1 EXISTING LAND USE PATTERNS

Major attention in this section is focused upon the area of residence of approximately 97 percent of Vandenberg employees. This area of Vandenberg, Lompoc, Santa Maria, and Santa Ynez is locally referred to as the North County in contrast with the South Coast, which comprises the Santa Barbara-Goleta area. The 4,000 ft-plus (1,219 m) Santa Ynez Mountains geographically separate the two areas and only two paved roads

traverse mountain passes at Gaviota and San Marcos to join the North County with the South Coast.

County Land Use (2.1.1)

The largest single land use activity in Santa Barbara County is the Los Padres National Forest which covers approximately 44 percent of the central and eastern county. This National Forest provides protected watershed for reservoirs in the Santa Maria and upper Santa Ynez Valleys as well as extensive recreation and limited grazing and mining.

Over 71 percent of the remaining 982,000 acres (392,800 ha) are in private agricultural cultivation and grazing uses. Vandenberg Air Force Base on the western coast of Santa Barbara County covers 10 percent of the non-National Forest land in the county. The remainder of the county area is devoted to urban and transportation uses.

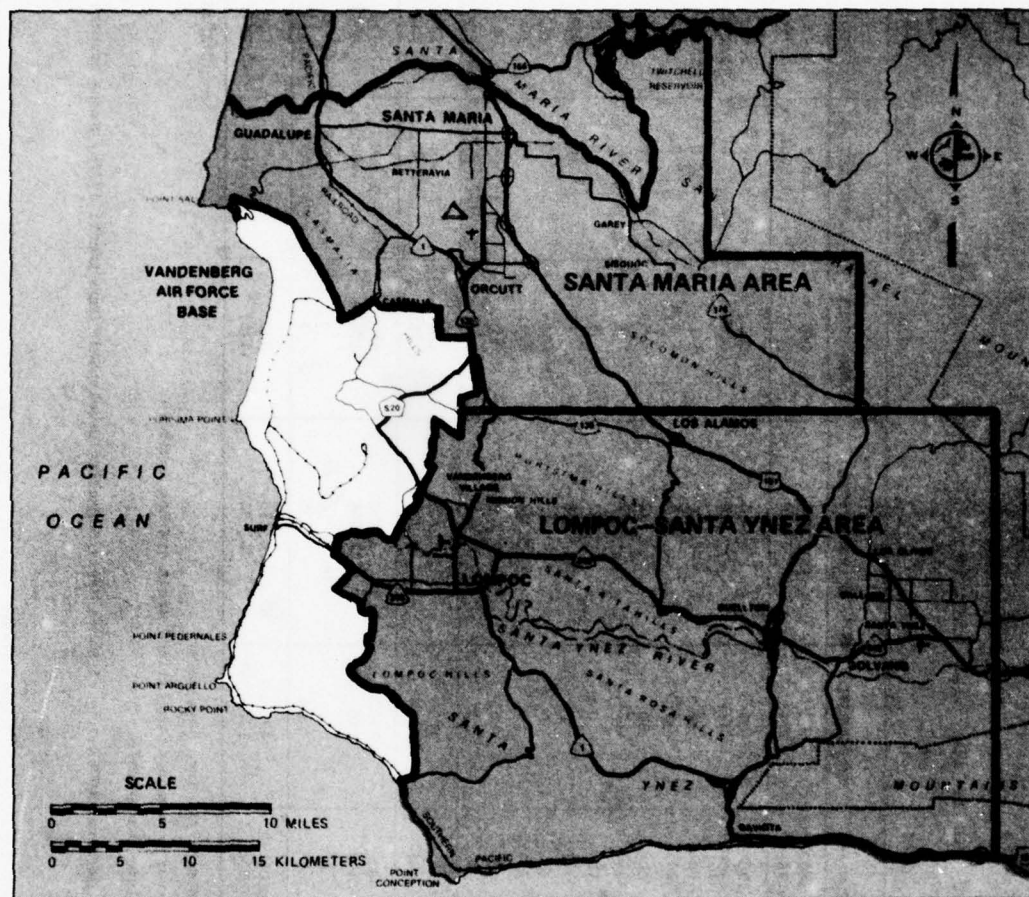
Land Use in the Base Environs (2.1.2)

The Santa Maria Valley to the north and the Lompoc and Santa Ynez valleys to the east constitute the key areas of anticipated impact. Land use in these areas has been tabulated and assessed in the two areas shown in Figure 2-1. The city of Lompoc and the unincorporated communities of Vandenberg Village, Los Alamos, Solvang, Santa Ynez, Buellton, Los Olivos, and Ballard are located in the Lompoc-Santa Ynez area. This study area, the larger of the two, extends from the base eastward approximately to the Los Padres National Forest.

Lompoc is the only incorporated city in the Lompoc-Santa Ynez area. Together with Vandenberg Village, it has the largest inventory of urbanized acreage within the area. Additionally 34,000 acres (13,600 ha) of cultivated crops are grown in the area, many of which are vegetables and grains (University of California at Santa Barbara, 1975). Much of the remaining agricultural acreage is given to the production of flowers and flower seeds; in fact, Lompoc is known as the flower seed capital of the world.

The Santa Maria study area reaches from the coast eastward to the National Forest. The Santa Maria area includes the incorporated cities of Santa Maria and Guadalupe as well as the unincorporated communities of Casmalia, Orcutt, Betteravia, Sisquoc, and Garey. Tabulated figures for land use in both areas are given in Table 2-1. Agricultural information included in the table represent cultivated acreage only. Those lands whose primary purpose is the grazing of animals are not included in the table.

From Table 2-1, it can be seen that the Santa Maria area with 60 percent of the population is more broadly developed with an industrial base



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Figure 2-1. Land use in the base environs is divided geographically by the Casmalia-Purisima Hills into the Santa Maria Valley to the north and the Lompoc-Santa Ynez Valleys to the east.

for employment and nearly twice the commercial land use than exists in the entire Lompoc-Santa Ynez area. In addition, public facilities for the North County are concentrated in Santa Maria. There are also 60 percent more acres in intensive cultivation in the Santa Maria Valley than in the Lompoc-Santa Ynez Valleys. These features all point to the Lompoc and Santa Ynez areas as bedroom communities for employment activities concentrated at Vandenberg, Santa Maria, and along the South Coast.

Table 2-1. Land use in the base environs, in acres (hectares).

COMMUNITY	RESIDENTIAL	COMMERCIAL	INDUSTRIAL	PUBLIC FACILITIES INSTITUTIONAL	OPEN SPACE	AGRICULTURAL	TOTAL ²
Lompoc-Santa Ynez Area	4,350 (1,740)	360 (144)	60 (24)	860 (344)	360 (144)	34,000 (13,600)	39,990 (15,996)
Lompoc-Vandenberg Village	1,740 (696)	200 (80)	20 (8)	560 (224)	290 (116)	0	2,810 (1,124)
Ballard-Los Olivos- Solvang	1,740 (696)	60 (24)	10 (4)	170 (68)	< 1 < 0.4	0	1,980 (792)
Buellton	280 (112)	80 (32)	30 (12)	20 (8)	< 5 < 2	0	415 (164)
Santa Ynez	470 (188)	10 (4)	0	100 (40)	5 2	0	585 (234)
Los Alamos	120 (48)	10 (4)	0	10 (4)	60 (24)	0	200 (80)
Nonurbanized Areas	0	0	0	0	0	34,000 (13,600)	34,000 (13,600)
Santa Maria Area ³	3,250 (1,300)	640 (256)	370 (148)	3,270 (1,308)	440 (176)	53,900 (21,560)	61,870 (24,748)
Santa Maria-Orcutt	3,250 (1,300)	640 (256)	370 (148)	3,270 (1,308)	440 (176)	1,200 (480)	17,450 (6,980)
Nonurbanized Areas	0	0	0	0	0	52,700 (21,080)	52,700 (21,080)
Total Study Area ²	7,600 (3,040)	1,000 (400)	430 (172)	4,130 (1,652)	800 (320)	87,900 (35,160)	101,860 (40,744)

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¹ Transportation land use is generally included in the land uses given.

² Does not represent acreage (ha) of total area; mountainous unutilized areas are not included.

³ Land use information for the city of Guadalupe unavailable.

Sources: University of California at Santa Barbara, 1975; City of Santa Maria Community Development Department, 1977a; Santa Barbara County Planning Department, 1977a.



The center of the city of Lompoc is at Ocean and "H" Streets. Nearly all south Vandenberg AFB traffic coming from southern or western Santa Barbara County passes this intersection.

Newer single family residences have been built into the steep hillsides in southeastern Lompoc.



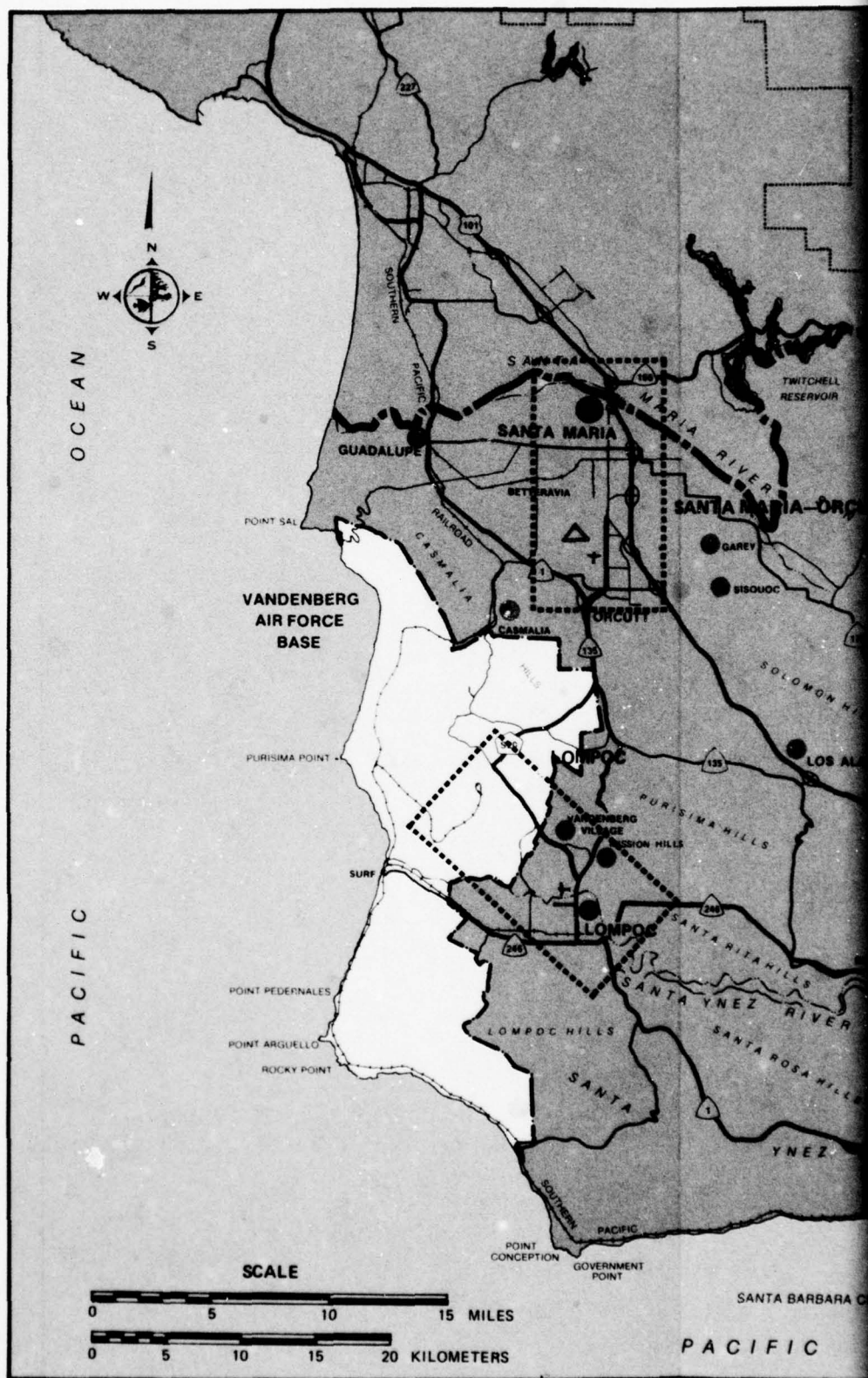
The following detailed evaluation of land use and land use trends in the Base Environs focuses on the three study areas of Santa Maria-Orcutt, Lompoc-Vandenberg Village, and Solvang-Santa Ynez. Santa Barbara County, the incorporated and unincorporated cities and the three study areas are presented in Figure 2-2.

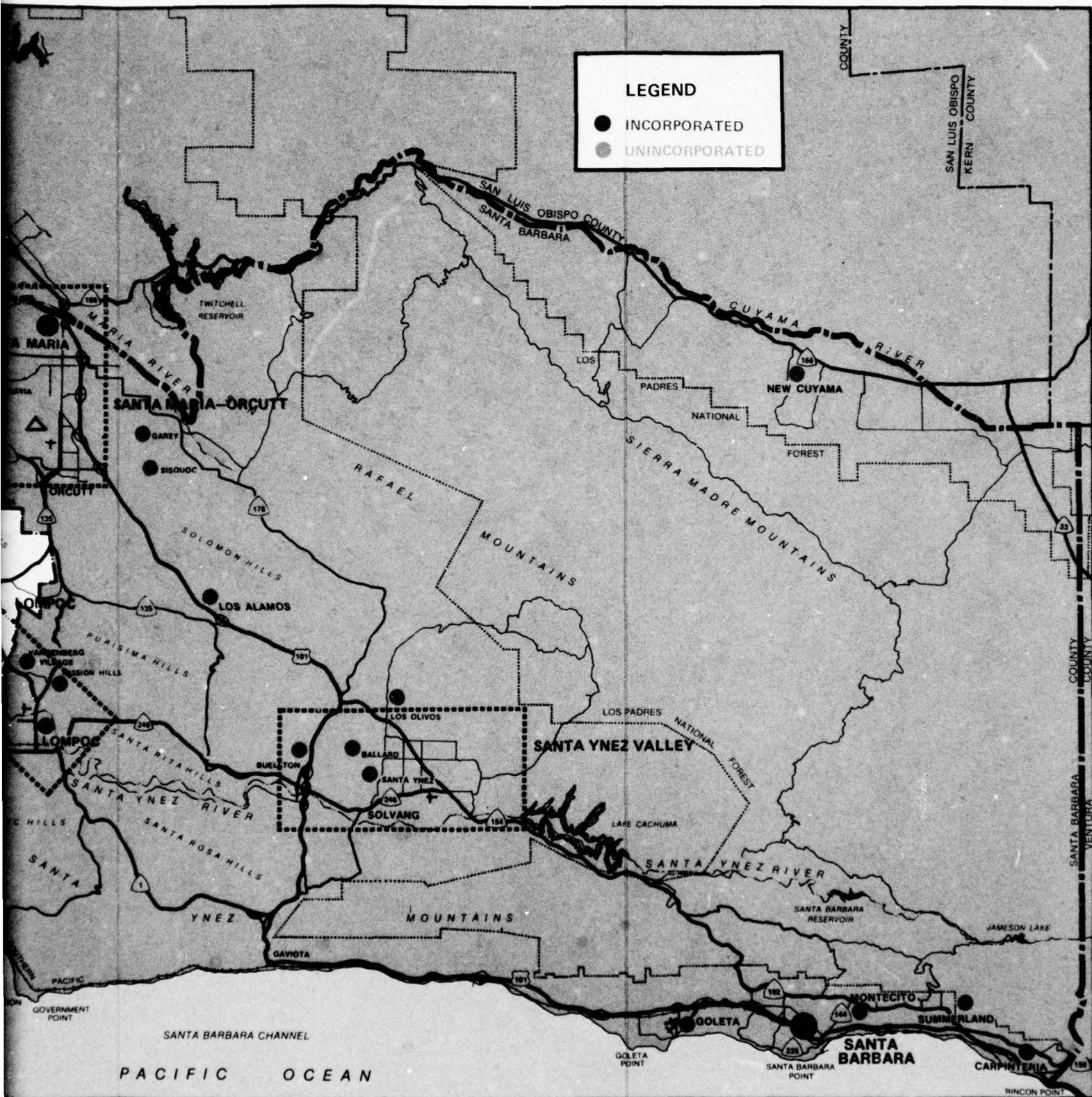
Lompoc Valley Land Use (2.1.2.1). The Lompoc Valley is largely rural with Vandenberg Air Force Base exerting a strong influence on the city of Lompoc and on County development in the valley. The city of Lompoc is built on a flat plain, and is characterized by a grid-street pattern. Figure 2-3 presents the land use in the Lompoc and Vandenberg Village areas. The Lompoc Central Business District (CBD) is a strip of commercial development running east-west along Ocean Avenue. Newer retail activity occurs north of this area along "H" Street. Multiple-family housing units tend to cluster around the commercial areas and single-family units congregate to the south, northeast, and northwest. The city's few industrial manufacturing uses are concentrated along the east-west rail spur and flower seed growing and diatomaceous earth (diatomite) processing are the key industries.

North of the city of Lompoc and separated from the city by the Santa Ynez River are two unincorporated residential areas: Vandenberg Village and Mission Hills. Vandenberg Village began in 1959 as a planned community with commercial and residential uses primarily for Vandenberg personnel and their families. The Village is on the southeastern portion of Burton Mesa, 5 mi (8 km) north of Lompoc, and covers approximately 660 acres (265 ha). The development currently has approximately 1,600 single-family residences and fewer than 100 multiple-family units as well as a shopping center. The Mission Hills subdivision, developed at about the same time as Vandenberg Village, is located about 3 mi (4.8 km) northeast of the center of Lompoc. Mission Hills has approximately 750 single-family residences. One additional population center adjacent to the base is the Federal Correctional Institution, which occupies 3,500 acres (1,400 ha) of land between the base's eastern boundary and Vandenberg Village. Large agricultural areas form a buffer between these urban centers and Vandenberg.

Santa Ynez Valley Land Use (2.1.2.2). The Santa Ynez Valley is a rural area, interspersed with small villages. Land use in these communities is detailed in Figure 2-4. Both Los Olivos and Ballard are small towns of medium-to-low residential densities with compact commercial centers. The Danish community of Solvang, with 2,700 residents, has a tourist-oriented commercial center emphasizing gift shops and bakeries along Highway 246. Small-lot single-family and multiple-family residential areas surround the business district with large residential lots farther from the center of town.

Figure 2-2. Incorporated and unincorporated cities in Santa Barbara and southern San Luis Obispo Counties and the three Base Environs study areas in northern Santa Barbara County.

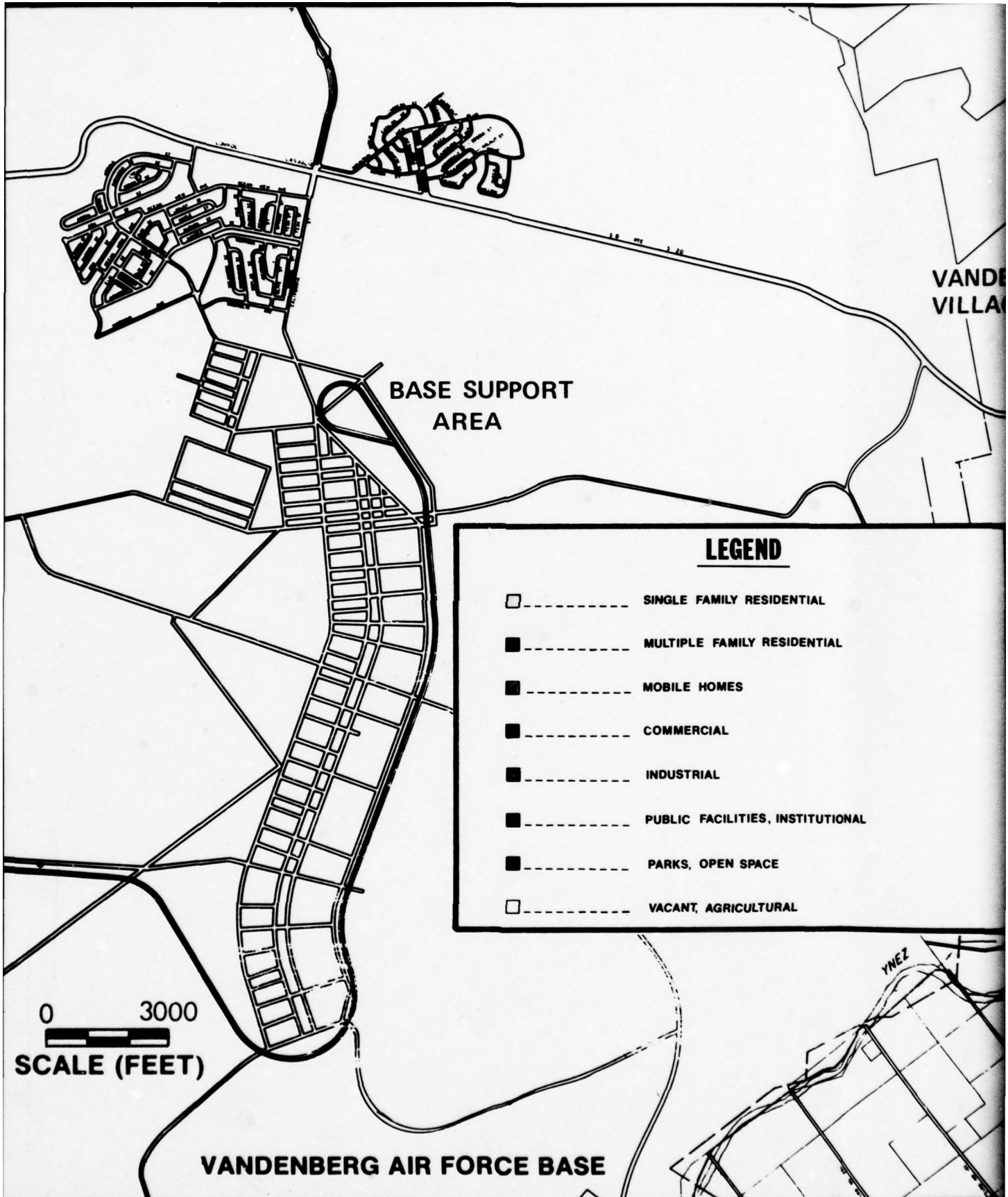


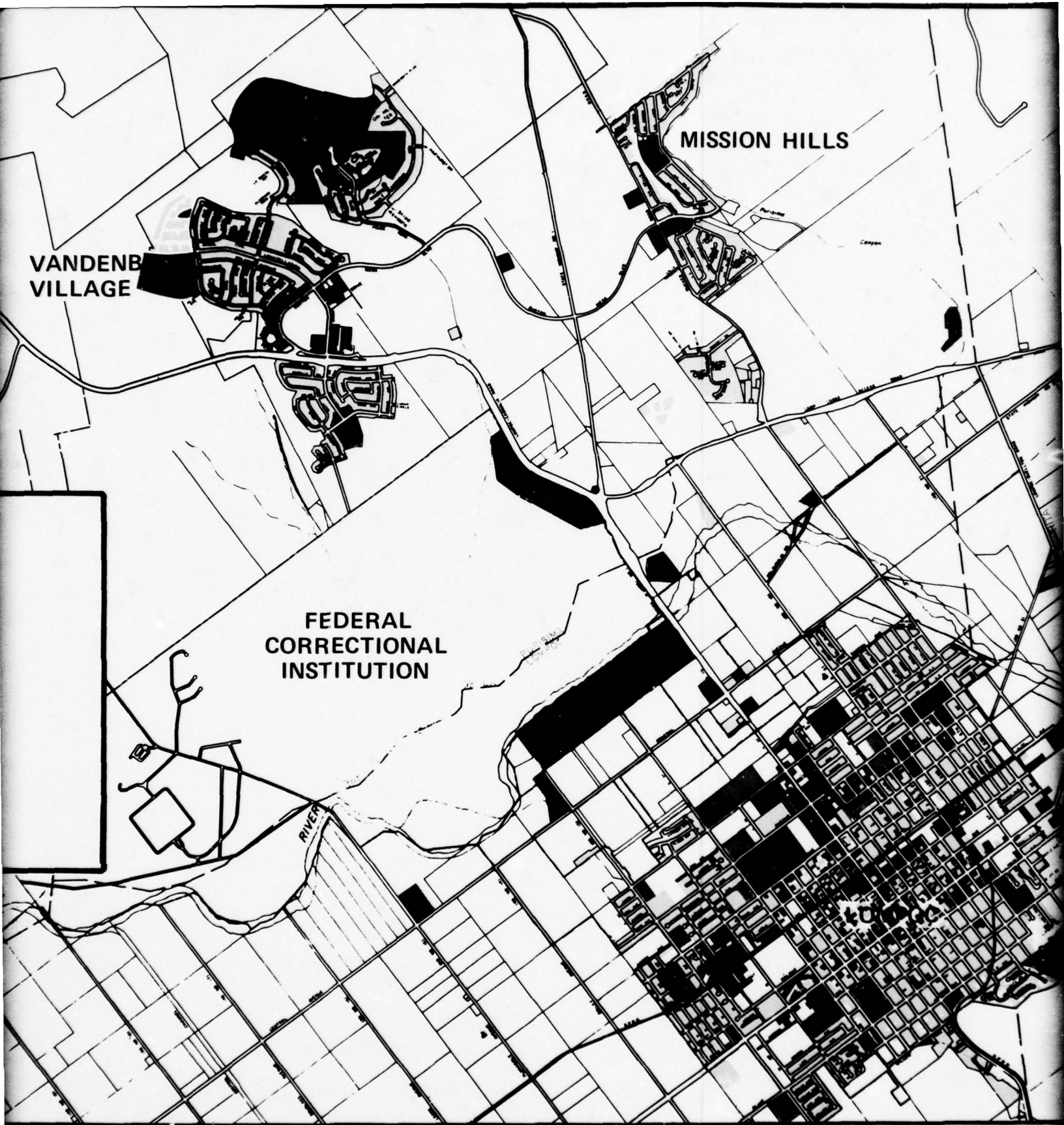


Missile Flight Testing

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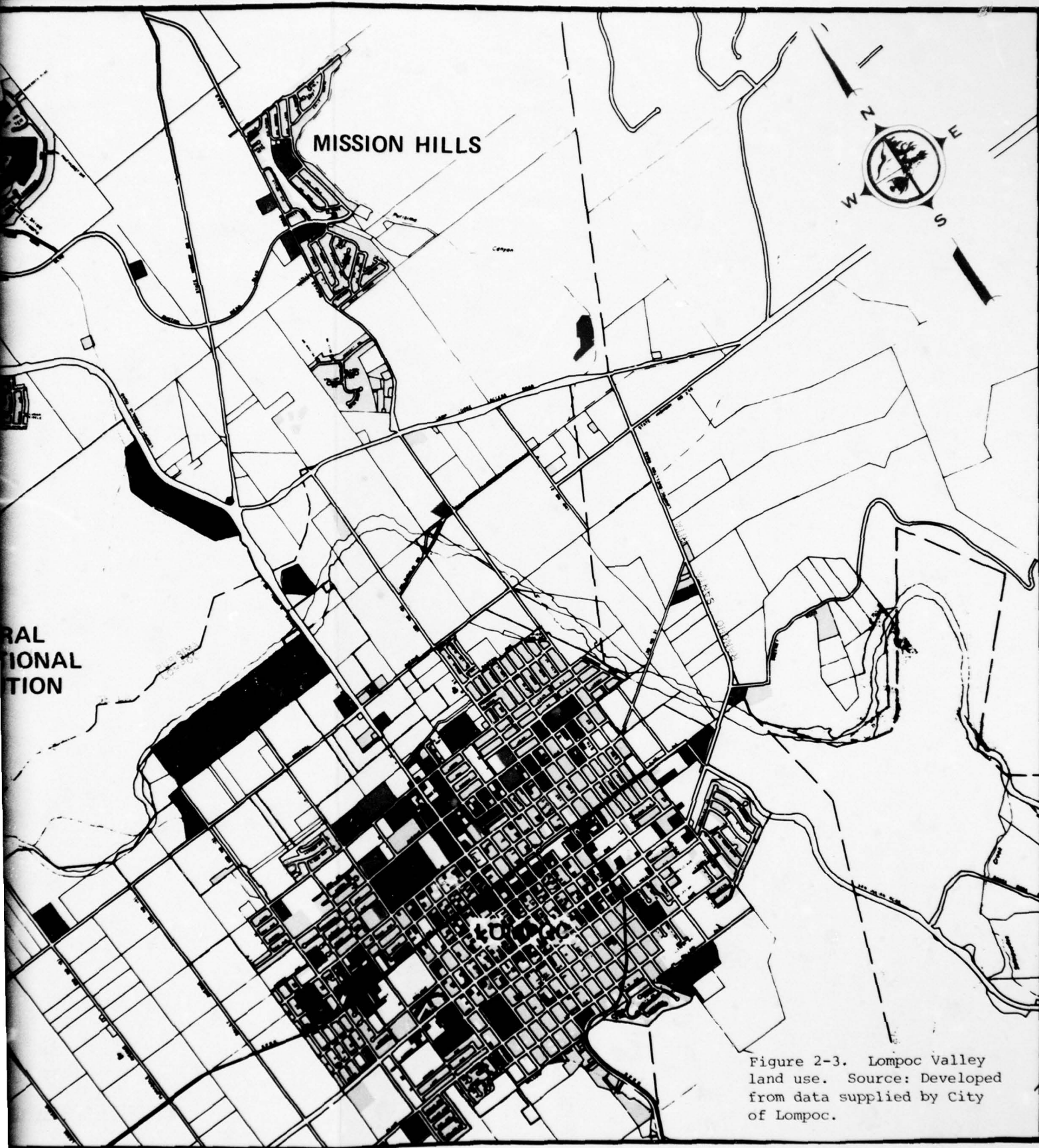


VANDENBERG
VILLAGE

MISSION HILLS

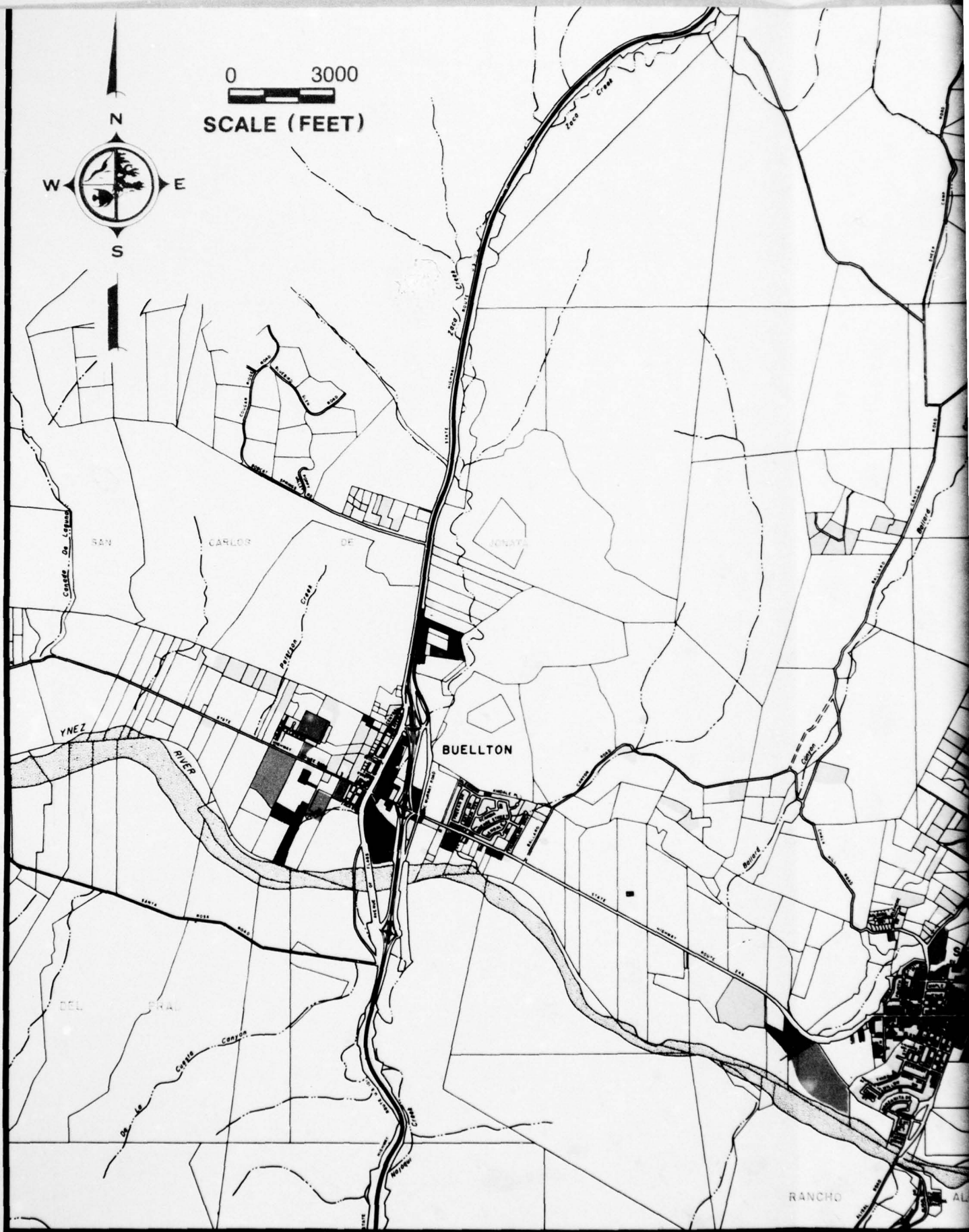
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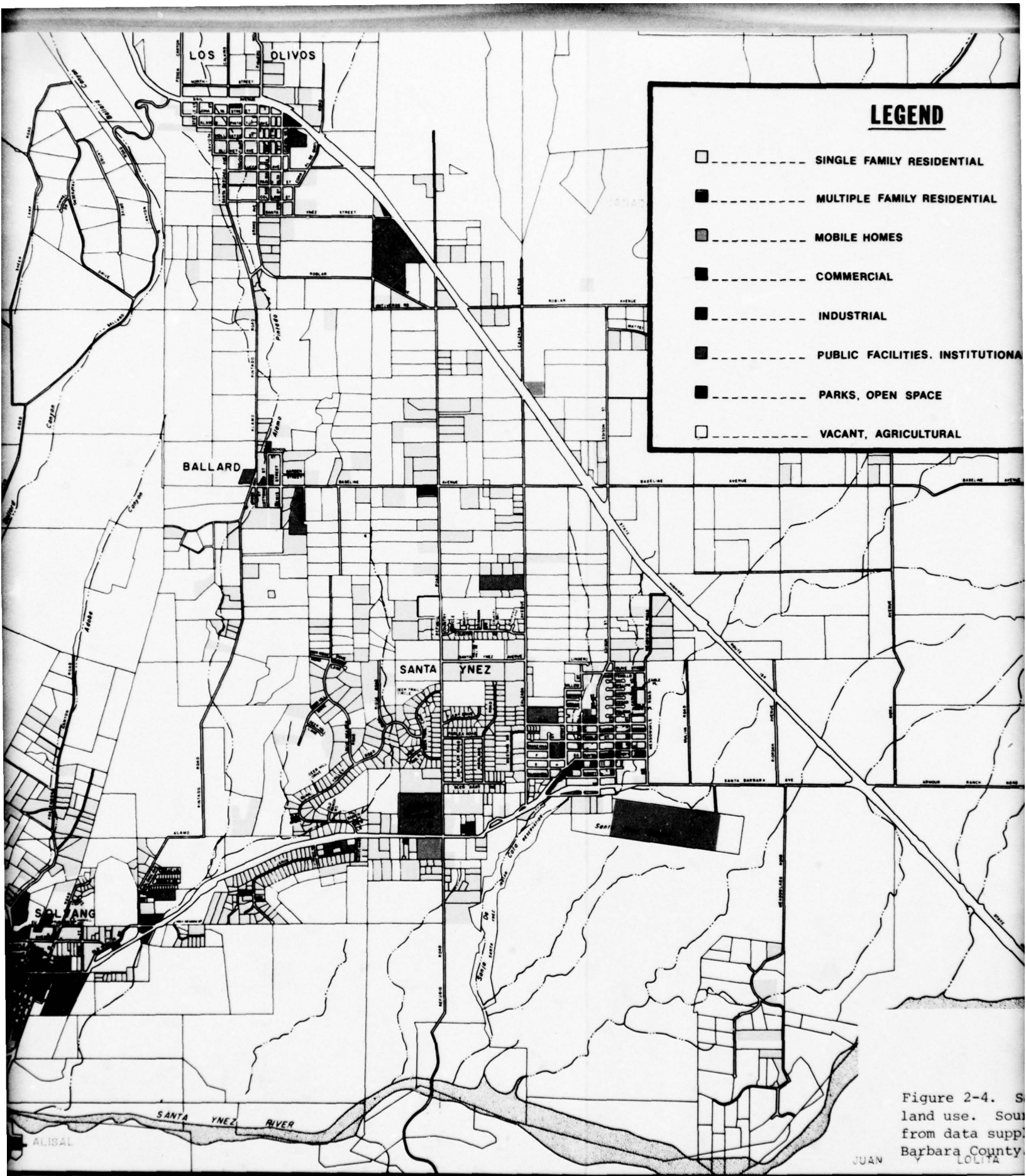


Figure 2-4. S
land use. Sou
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Barbara County
JUAN LOLITA

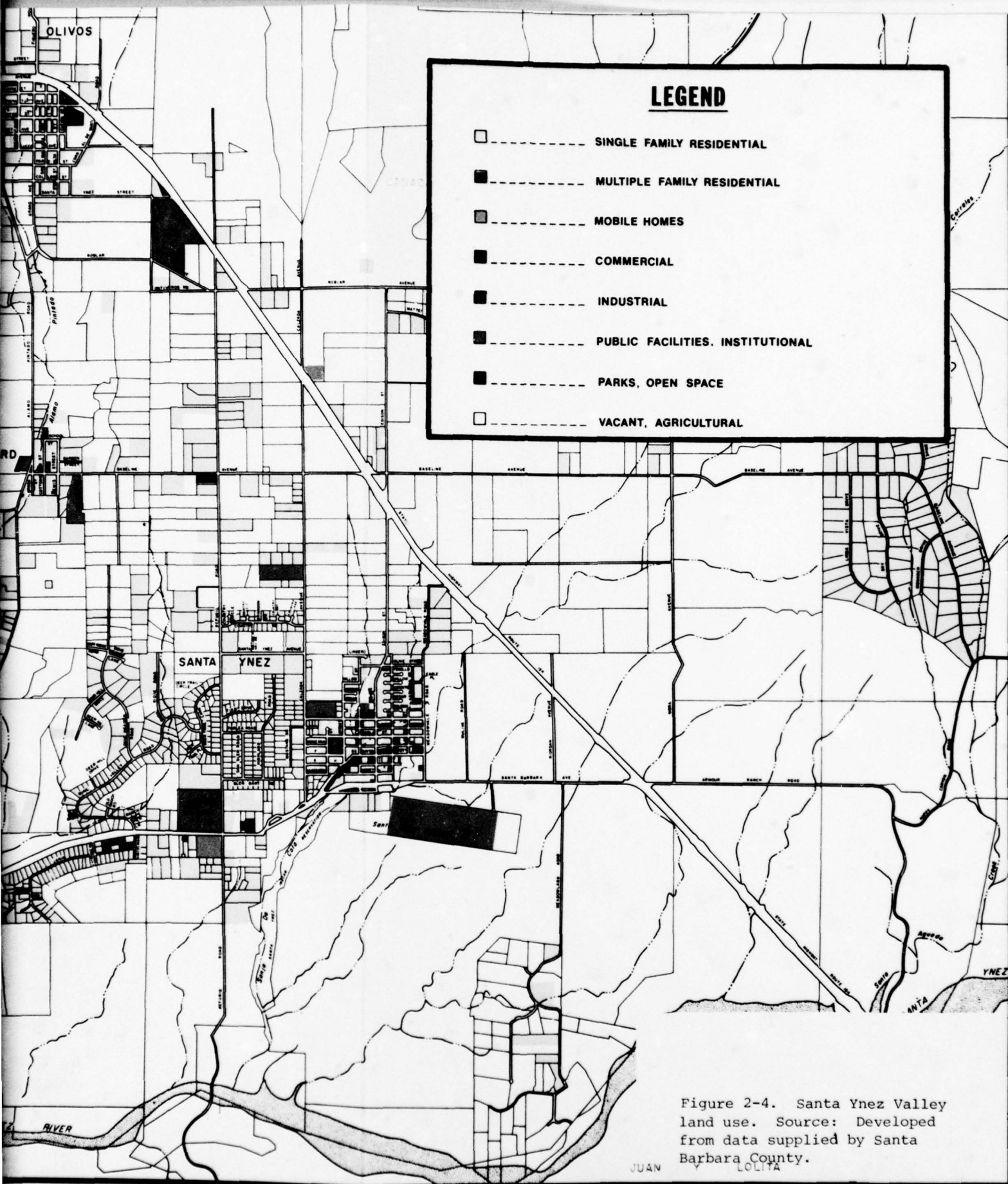


Figure 2-4. Santa Ynez Valley land use. Source: Developed from data supplied by Santa Barbara County.

The community of Santa Ynez east of Solvang is composed of single-family residences with a small restored commercial area surrounded by 1 acre (0.4 ha), 5 acre (2.0 ha), and 20 acre (8.0 ha) mini-ranches. Santa Ynez is the largest identifiable community in the valley with approximately 2,800 residents.

Buellton, west of Solvang, is located at the intersection of U.S. Route 101 and State Highway 246. With approximately 1,800 residents, it is the third largest community in the Santa Ynez Valley. Although the town has fewer people than either Solvang or Santa Ynez, its commercial acreage exceeds that of both. Much of the commercial development in Buellton is due to its position on U.S. Route 101 as a freeway service stop.

Santa Maria Valley Land Use (2.1.2.3). Land use in Santa Maria and Orcutt is presented in Figure 2-5. Agricultural land uses predominate the Santa Maria area with over three-fourths of utilized land devoted to cultivated agricultural crops. Grazing lands cover nearly all "unutilized" land in the area. Urbanized land uses in the area are dominated by the incorporated city of Santa Maria and the Orcutt-Y area. The city of Guadalupe on the western end of the Valley is also an agricultural area.

The Santa Maria-Orcutt area has a population of 53,250. Santa Maria's streets are laid out almost entirely in a grid pattern, and the vast majority of the office buildings, stores, and houses are low one and two story structures. The streets in the city are wide,

The Danish village of Solvang in the Santa Ynez Valley, with one windmill for each 600 residents, claims to have the highest number of windmills per capita in the world.



Santa Maria Valley's rich soil provides truck crops for both the state and nation. Many sugar beets grown here are processed at Union Sugar's Betteravia plant. Vandenberg AFB is located on the other side of the hills in the background.



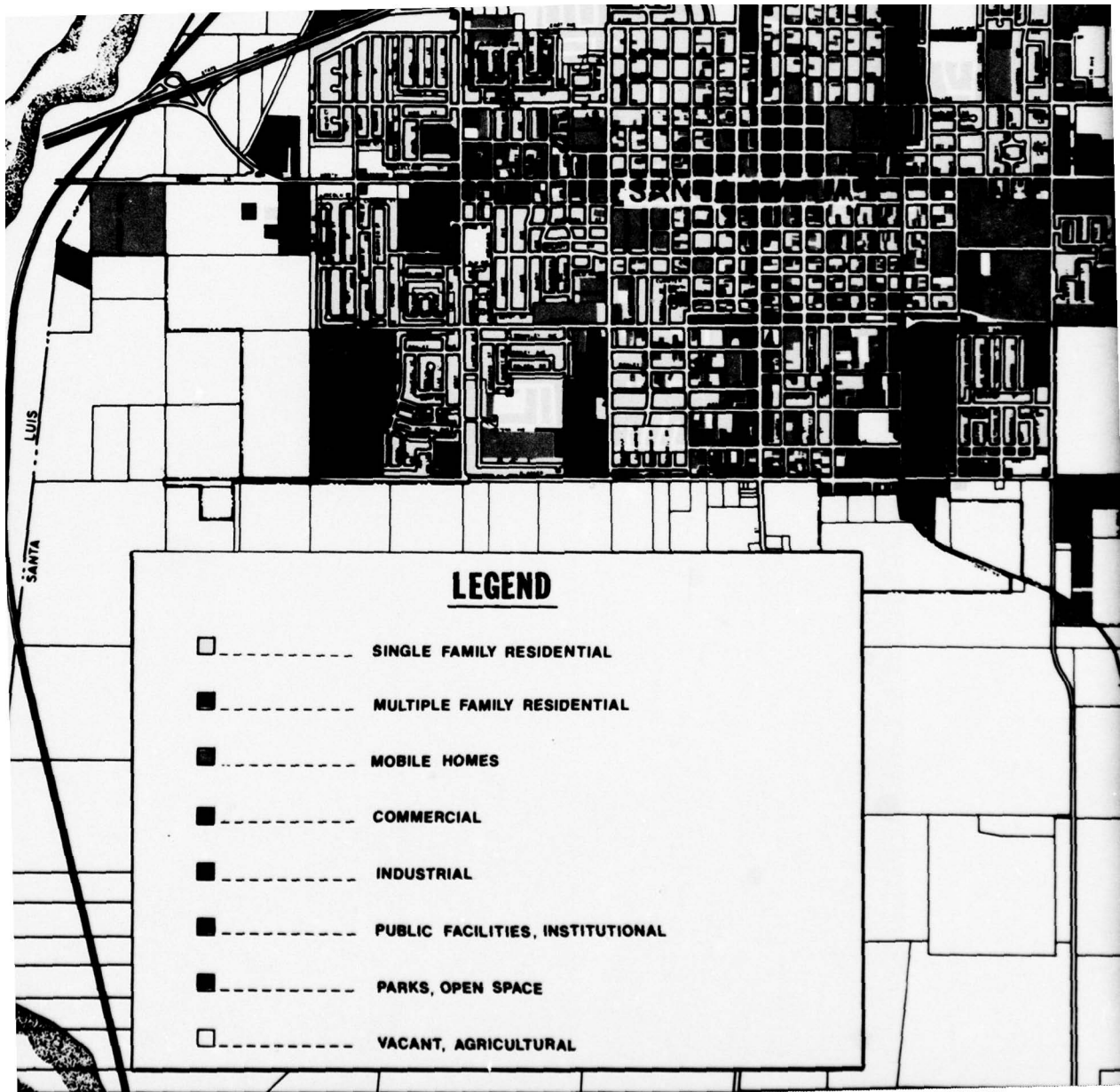
designed to turn around a four-horse rig, and easily accommodate four lanes of traffic, a center divider, and parallel parking. Until the mid-1970s, the downtown area consisted primarily of commercial structures built in the 1920s and 1930s with older residences located in and around the Central Business District (CBD) and new commercial development south of the city between Santa Maria and Orcutt. The current urban renewal program for the CBD has altered this use pattern and has concentrated the area's largest shopping center at the central intersection of Main Street and Broadway. Housing construction which occurred during the early 1960s was generally located south of the city center along the main route to Vandenberg Air Force Base.

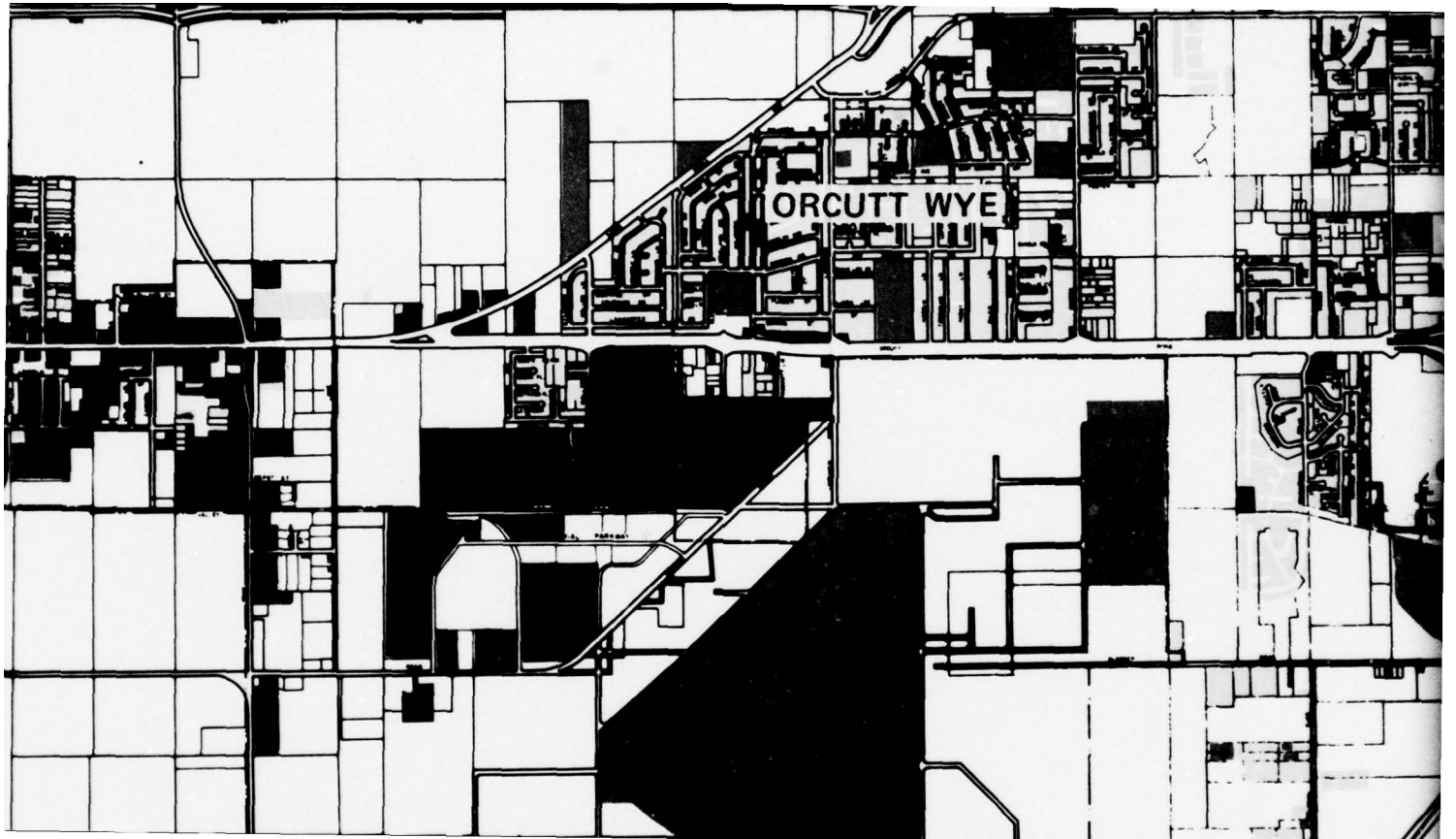
The Orcutt-Y area concentrated this development in the Y created when Orcutt Road (now S-20) and old Highway 101 converged to become Santa Maria's Broadway.

Constructed chiefly on uncultivable sand dunes in the early 1960s, this series of medium density single-family residential developments was closer to Vandenberg AFB than the valuable prime agricultural land surrounding Santa Maria. Recent residential development during the 1970s has taken place on rich agricultural land to the east of Santa Maria.

Industry around the Santa Maria Airport and rejuvenation of the Orcutt oil fields as well as expanded governmental services have resulted in a more stabilized Santa Maria-Orcutt economy, although approximately 28 percent of the area's 53,250 residents still receive their incomes either directly or indirectly from Vandenberg.

III-204 Missile Flight Testing





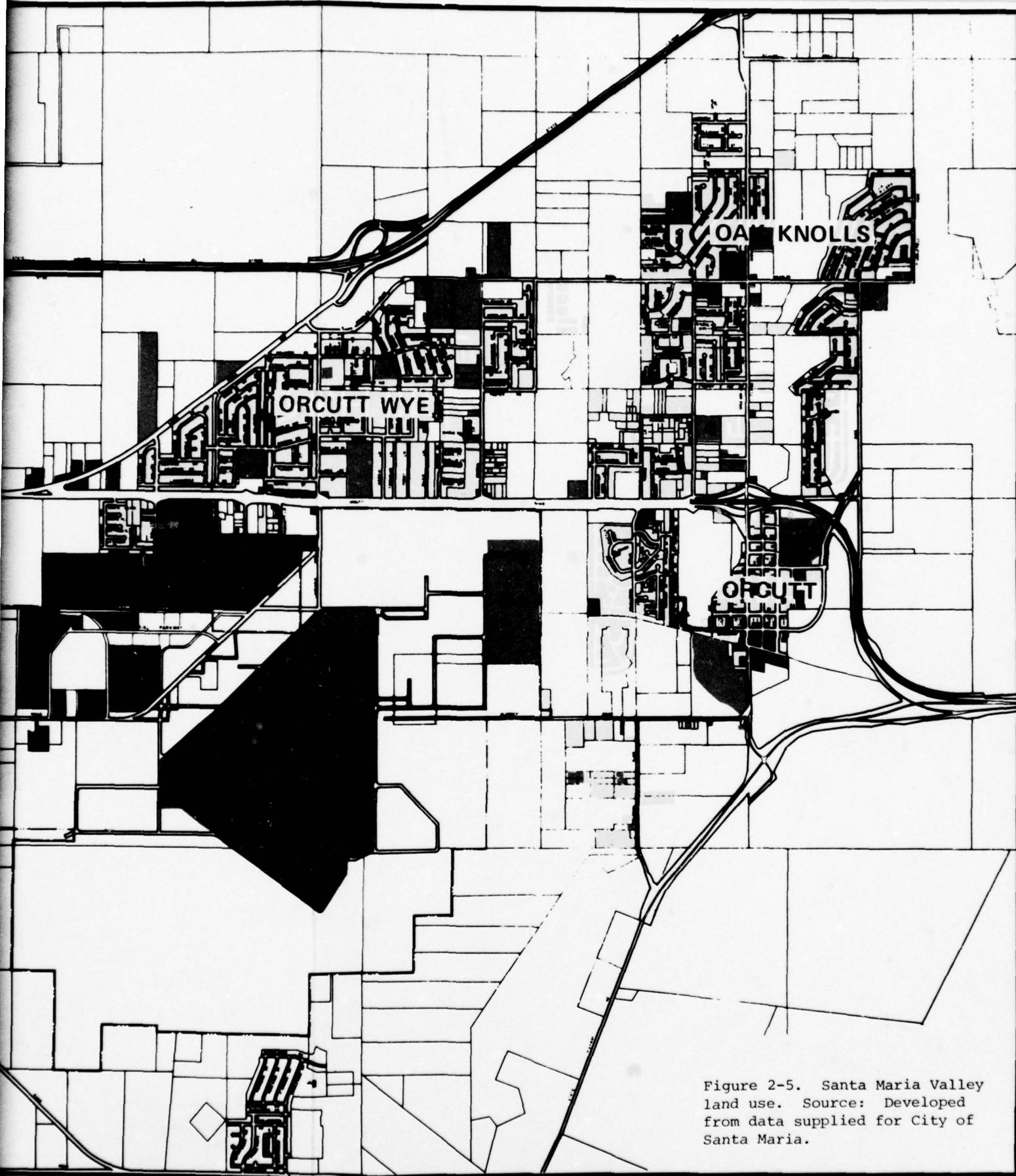
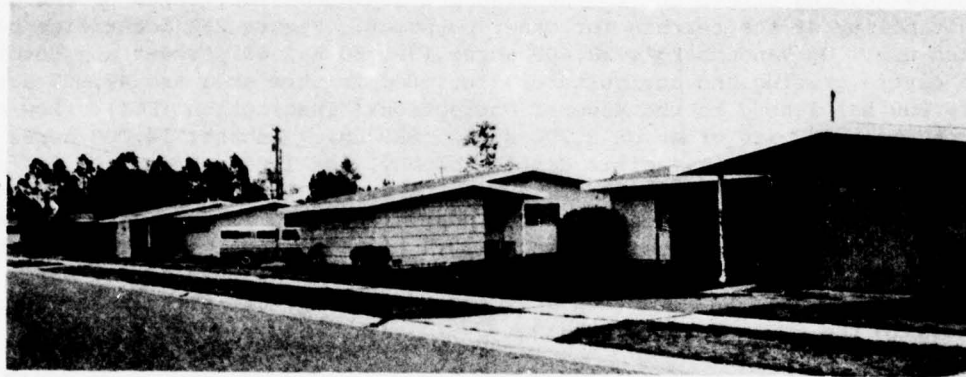


Figure 2-5. Santa Maria Valley
land use. Source: Developed
from data supplied for City of
Santa Maria.

Existing Land Use Patterns on Vandenberg AFB (2.1.2.4). Land use within Vandenberg boundaries closely parallels the land use of its environs with extensive open space within a very rural expansive area. Vandenberg is divided into North and South segments by the Santa Ynez River and Ocean Avenue which extends to Surf.



On base, single-family housing, shown above, and the general quality of life is similar to that obtained in the residential portions of Vandenberg Village, Mission Hills, and Lompoc. Vandenberg AFB and Burton Mesa are in the background of the photograph below, which shows a residential section of Lompoc.



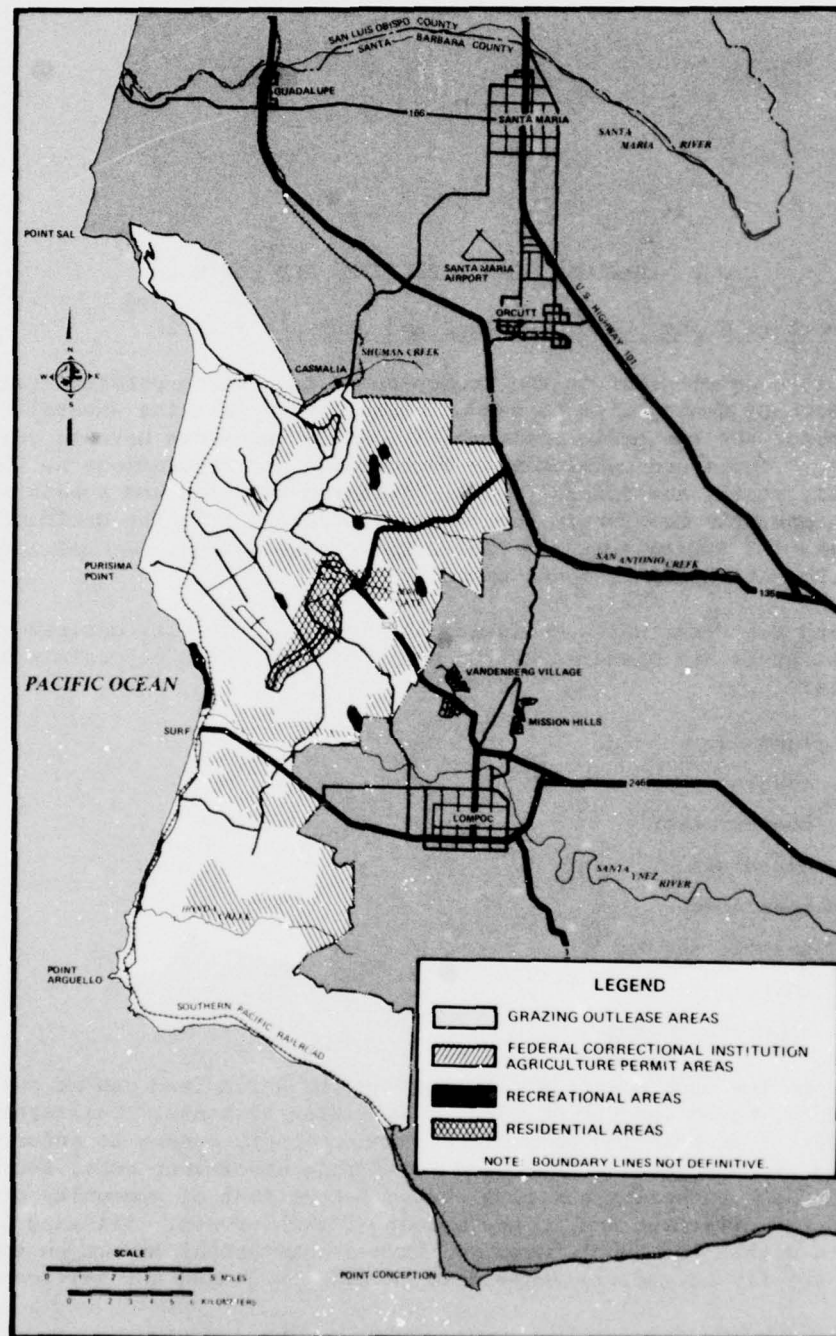
Near the center of the base in North Vandenberg on Burton Mesa is the 6,000 acre (2,400 ha) cantonment area with personnel support, housing, cafeteria facilities and dining halls, schools, the base hospital, commercial services, and recreation. The Vandenberg airfield is located a short distance west of the cantonment and is scheduled for substantial improvements as part of the Space Shuttle program.

Much of the land on the base is restricted to use as open space and cattle grazing either due to the presence of launch facilities or the unsuitability of the terrain for other purposes. Figure 2-6 identifies base land use. Of Vandenberg's 98,400 acres (39,360 ha) 60 percent are devoted to cattle grazing and agriculture. Included in this area are 42,000 acres (16,800 ha) leased to the Federal Correctional Institution (FCI). Row crops such as barley are grown on 2,200 acres (880 ha). Another 14,000 acres (5,600 ha) are rented to the Pacific Cattle Company, and 1,000 acres (400 ha) are leased to the Cagianut Ranch (Vandenberg AFB, 1978). Overgrazing of base rangelands has been a problem in the past, resulting in decreased forage production, increased erosion, and growth of undesirable vegetation. The Air Force has funded a Grazing Management Study to be used as the basis for a Grazing Management Plan, not only for Vandenberg, but for all Air Force bases in the western United States.

Scattered recreational sites and special interest areas also exist on base; three beaches, two sets of lakes, a golf course, saddle club, and a picnic area are among the recreational facilities available within the base boundaries. Scenic highways and areas of botanical and geological interest are also located on base. A coastal corridor has been granted through the base for use by the Southern Pacific Railroad.

Vandenberg AFB land use is nearly identical to that in the Base Environs. Sixty percent of the base's 98,400 acres (39,360 ha) are devoted to cattle grazing and agriculture.





372P-459-2

Figure 2-6. Agricultural, recreational, and residential land use at Vandenberg AFB.

2.2 LAND USE PLANS, POLICIES AND CONTROLS

Santa Barbara County Land Use Plans and Controls (2.2.1)

Future development in the incorporated and unincorporated areas of Santa Barbara County will be guided basically by existing General Plans and zoning, the two basic tools which local governments have to guide land use. These are supplemented by agencies and regulations at the regional, state, and federal level, including taxation and subdivision regulations, the California Environmental Quality Act, the National Environmental Policy Act, the California Coastal Commission, and Local Agency Formation Commissions, among others.

Land Use Plans which delineate the types of activity desired in specific areas are mandated by the State of California to contain specific elements:

- land use
- housing
- conservation
- circulation
- open space
- seismic safety
- noise
- scenic highways

California law also requires the legal use to which land can be put, the zoning, to be consistent with General Plan elements. California law gives broad standing to residents and property owners to enforce this requirement (*West's Annotated California Government Code, Section 65860*). Such authority can be a strong determinant of community growth, both in the direction and in the extent of such growth. All land use controls within the county combined have a substantial impact on the area's ability to rapidly respond to changes in demand for services.

The key variable in determining future development patterns, not only in the Lompoc-Santa Ynez and the Santa Maria-Orcutt areas, but also in the county as a whole, is the stability of agricultural uses over time in the vicinity of urban areas. This variable, in turn, depends on the development policies in Santa Barbara County and in the incorporated cities; the possible limitation of future urban growth in the South Coast region by continuing restrictions on land, water, and existing public services; and the economic viability of continued agricultural uses in selected areas.

Santa Barbara County is currently in the process of updating and adding the required General Plan elements, as is the city of Santa Maria. The city of Lompoc has updated most of its General Plan elements, including land use. Table 2-2 gives the General Plan status for the region's communities. The adopted General Plans for guiding land use development, both in Santa Barbara County and in the city of Santa Maria, will soon be superseded by major revisions.

County officials do indicate that the General Plan and required zoning will probably be used as a primary tool for a moderate growth policy (Santa Barbara County-Cities Area Planning Council, 1976). This moderate growth policy was selected from three population forecasts to provide a basis for the proposed Land Use Element of the Santa Barbara County Proposed Comprehensive Plan to be completed by mid-1979. The proposed County Land Use Element differs from the existing General Plan in several ways that could affect Vandenberg.

- Recommended urban expansion in the Vandenberg Village-Mission Hills area is significantly less than in the existing General Plan;
- A much lower capacity for new development is projected for the Lompoc area;
- Land southwest of the Santa Maria Airport intended for residential development in the present General Plan has been recommended as open space.

Land Use Plans and Controls in the Base Environs (2.2.2)

Land Use Plans and Controls in the North County are administered by either the incorporated cities or the county. A dominant feature of all Land Use Plans and Controls in the Base Environs is the retention of agricultural land. Figure 2-7 identifies the areas in the county currently in agricultural preserve status. An agricultural preserve under the Williamson Act permits taxation at less than highest and best use on the assumption that the positive community benefits obtained from broad green belt areas more than compensate for the subsidization of the taxes on these areas by urban residents.

Table 2-2. General Plan status for Santa Barbara County, Lompoc, and Santa Maria.

MANDATED ELEMENTS	COUNTY OF SANTA BARBARA			CITY OF SANTA MARIA			CITY OF LOMPOC		
	ADOPTED BY BOARD OF SUPERVISORS	PLAN DEVELOPMENT OR REVISION IN PROCESS	ESTIMATED TARGET	ADOPTED BY CITY COUNCIL	PLAN DEVELOPMENT OR REVISION IN PROCESS	ESTIMATED TARGET	ADOPTED BY CITY COUNCIL	PLAN DEVELOPMENT OR REVISION IN PROCESS	ESTIMATED TARGET
Land Use	1965 plus Revisions to Date	Revisions	1978	1965	Revisions	1977	1974	Revisions	Continuous
Circulation	1965 plus Revisions to Date	Revisions	1978	1965	Revisions	1978	1967	Revisions	1979
Housing	1969 (Initial)	Revisions	1978	1977	No	--	1975	Revisions	Continuous
Open Space	1973 (Interim)	Revisions	1978	1973	Revisions	1978	1974	Revisions	Continuous
Conservation	No	Development	1978	No	Development	1978	1974	Revisions	Continuous
Seismic Safety	No	Development	1978	1977	No	--	1974	Revisions	Continuous
Scenic Highways	1975	No	--	No	Development	1978	1974	Revisions	Continuous
Noise	No	Development	1978	1976	No	--	1974	Revisions	Continuous
Safety	No	Development	1978	1977	No	--	1975	Revisions	Continuous
PERMISSIVE ELEMENTS									
Public Buildings	1965	No	--	1967	No	--			
Public Facilities	1965	No	--	1968	Revisions	1977	1965	Revisions	Continuous
Parks and Recreation	1965	Revisions	1978	1972	No	--			
Equestrian and Hiking Trails	1969	Revisions	1978				1965	Revisions	Continuous
Bikeways	1975 (Partial)	Development	1978				1974	Revisions	1979
Water and Sewer							1972	Revisions	Continuous

Sources: Santa Barbara County Planning Department, 1977b; City of Santa Maria Community Development Department, 1977b; City of Lompoc Community Development Department, 1977.

3/2T-3032

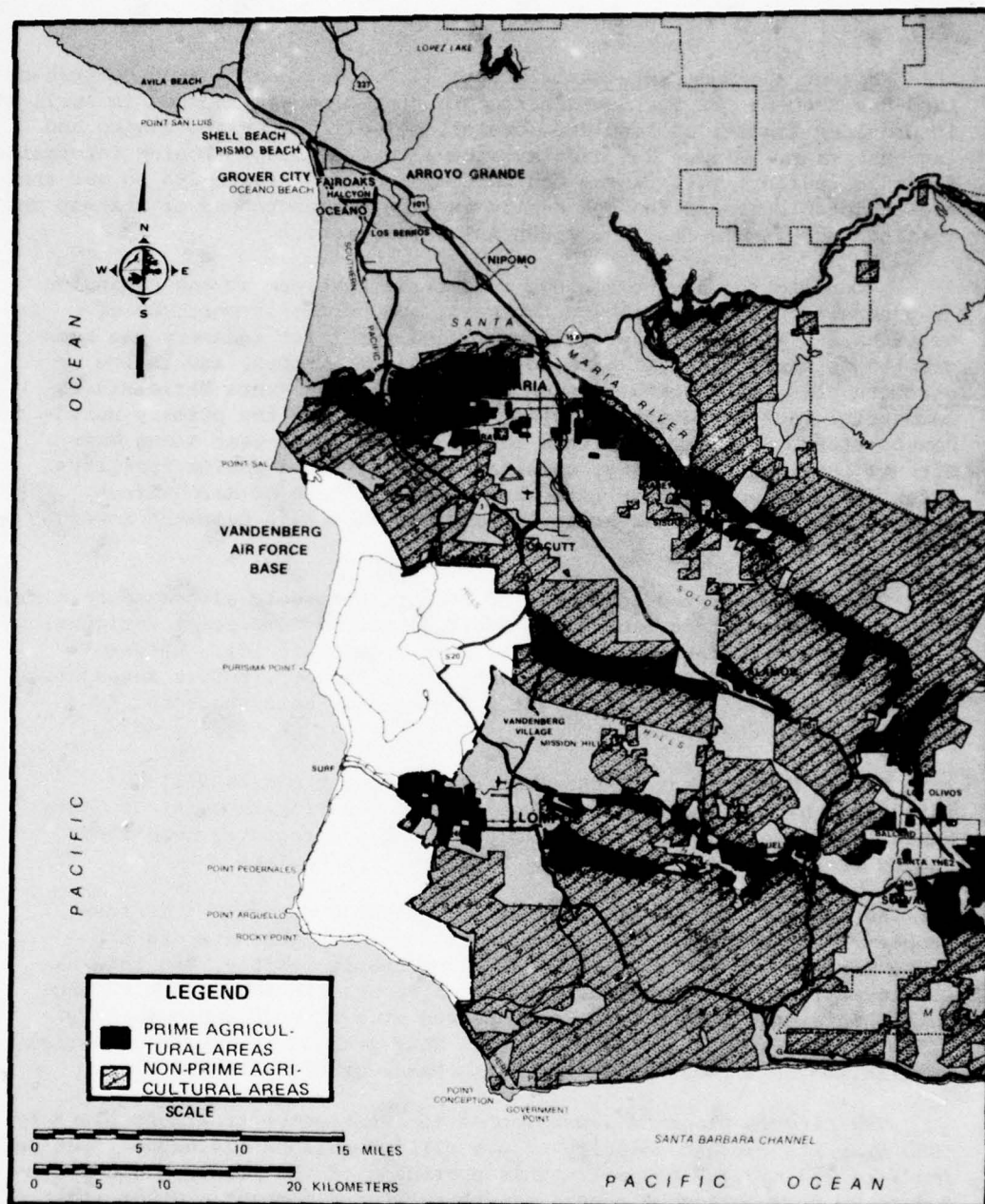


Figure 2-7. Agricultural preserves in Santa Barbara County (Santa Barbara County Assessor's Office, 1977b).

372P456-3

Present Zoning—Santa Maria/Orcutt (2.2.2.1). An updated Comprehensive Land-Use Element for the Santa Maria/Orcutt region was adopted in April 1978. It provides figures on land-use acreage, as well as revised zoning and land-use maps. Figure 2-8 displays the latest available zoning information for this region. This figure can be compared with Figure 2-5 to see the areas, notably around the Oak Knolls area on the south end of the map which is zoned for single family residential development.

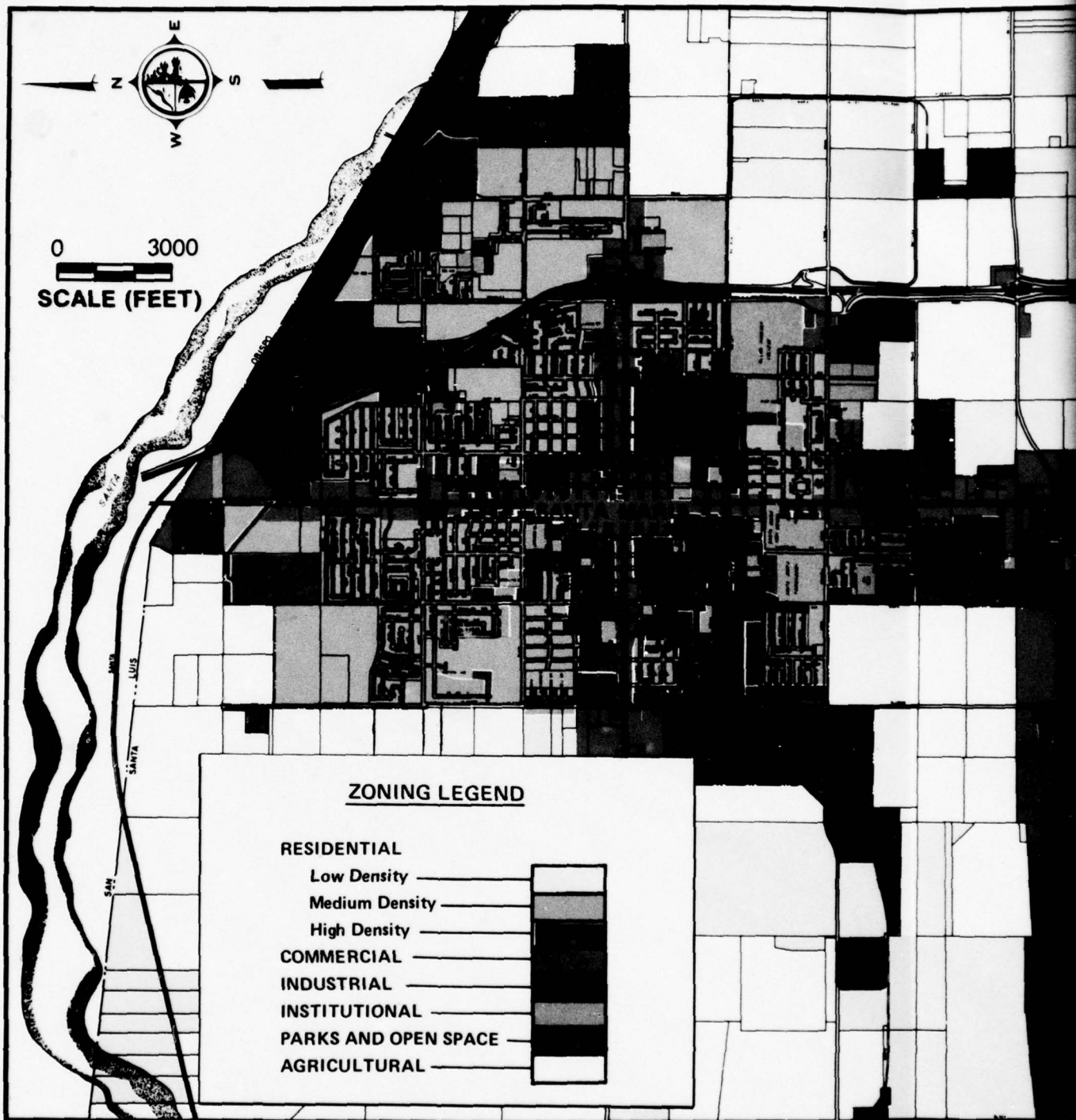
According to current zoning, industrial development and expansion is generally slated for the south, west, and northeast portions of Santa Maria. A generous provision of land for light industry has been granted in the industrial park adjacent to the airport, and in the northern part of the city between U.S. 101 and the Santa Maria River. Commercial facilities are expected to cluster along the primary north-south artery, Broadway, and to a lesser extent, east-west along Main Street. Residential zoning, combined with scattered public facility sites, will group together into three areas: south of Main Street, north of Main and west of Broadway, and north of Main eastward toward the Santa Maria River.

The unincorporated community of Orcutt is largely allocated to medium-density residential development. Small scattered commercial designations have been placed, for the most part, near U.S. Route 101. Between Orcutt residential areas and the Santa Maria Airport, buffer zones for uses such as agriculture and light industry have been suggested to minimize noise conflicts.

Future development in the Santa Maria-Orcutt region will be influenced by the newly adopted Land-Use Element for the city of Santa Maria, the existing County General Plan, and the recently completed Sphere of Influence Study for the Santa Maria area.

An adequate supply of good quality drinking water is a serious problem for the Santa Maria-Orcutt area. Much of the water in the Santa Maria groundwater basin is of questionable quality, and this has led to reliance on the better quality water held in the Orcutt storage unit. This unit is now being overdrafted at a rate of approximately 5,500 acre/ft ($6.8 \times 10^6 \text{ m}^3$) per year. This problem remains a potential restriction on growth within the Santa Maria-Orcutt planning area.

The city is planning expansion of the wastewater treatment plant by 1980 from its current capacity of 6.5 million gallons ($24,620 \text{ m}^3$) per day (mgd) to 7.3 mgd ($27,650 \text{ m}^3$). This upgrading of the plant should accommodate up to an extended annual growth rate of 4 percent. Other areas of concern include reducing the sodium content of the discharge to meet Regional Water Quality Standards, investigation of the costs of a lift station for the Blosser Sewer Basin, and ensuring that development on the east side does not overburden drainage patterns (City of Santa Maria Community Development Department, 1977d).





372P-470

Figure 2-8. Current zoning for the Santa Maria/Orcutt area (City of Santa Maria Community Development Department, 1977a; Santa Barbara County Planning Department, 1974).

Missile Flight Testing III-215

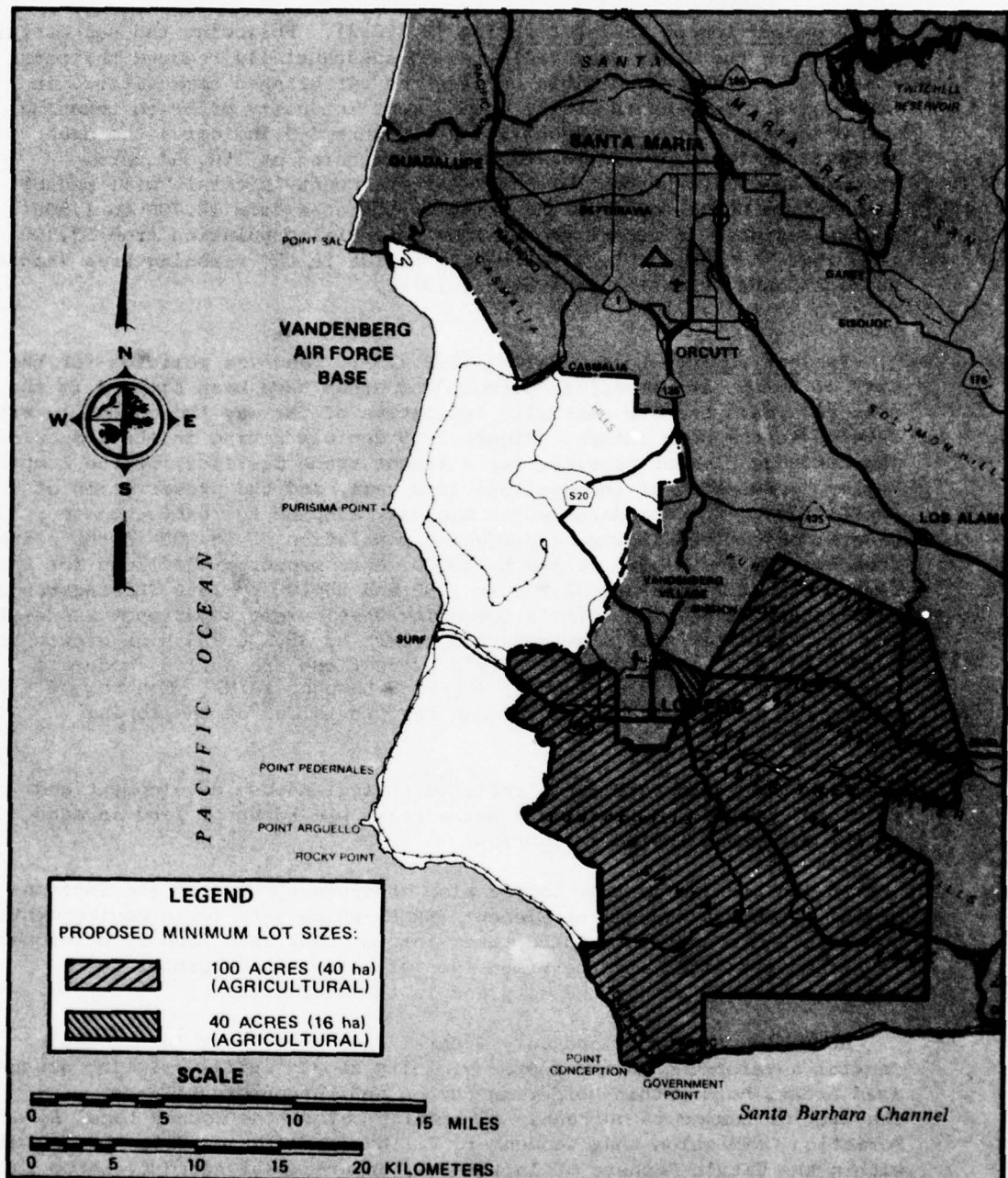
Proposed Lompoc Valley Rezoning (2.2.2.2). Following the successful rezoning of the Santa Ynez Valley which substantially reduced the total number of residences possible outside the established communities, in some cases to one-tenth of the development intensity prior to rezoning two major areas of the Lompoc Valley. Figure 2-9 indicates the area involved in the proposed rezoning. The rezoning of 150,054 acres (60,022 ha), 15.3 percent of Santa Barbara County's total, will reduce the maximum number of dwelling units in the area from 12,700 to 1,500 and is designed to reduce the maximum potential population from 32,700 to 5,200. A total of 1,447 currently reside in the rezoning area (Santa Barbara County Planning Department, 1978).

Present Zoning—Lompoc Valley (2.2.2.3). Land-use policies for the City of Lompoc and immediate surrounding areas have been adopted in the past few years and are generally indicative of the way the community will develop in the near future. Figure 2-10 depicts zoning in the Lompoc area. The Land-Use Element provides for a linear trade district for the Lompoc Valley, prevention of incompatible land uses, and the preservation of agriculture. The standards which the city adopted to realize these general objectives include a projected population of 58,000 in the planning area by 1980 and 71,000 people by 1990. More recent projections for the Lompoc Planning Area are 32,900 in 1980 and 35,100 by 1990 (Livingston and Associates, 1976). The city's Community Development Department is developing new estimates that show moderate growth to 32,900 and high growth to 36,200 by 1980. For 1990 the city's projections are 35,100 (moderate growth) and 41,400 (high growth) (City of Lompoc, 1978). Control of population is to be achieved through the provisions of the zoning ordinance.

Lompoc's zoning ordinance reflects these land-use development and policies. Table 2-3 presents a net acreage breakdown of land in each of the different zoning categories.

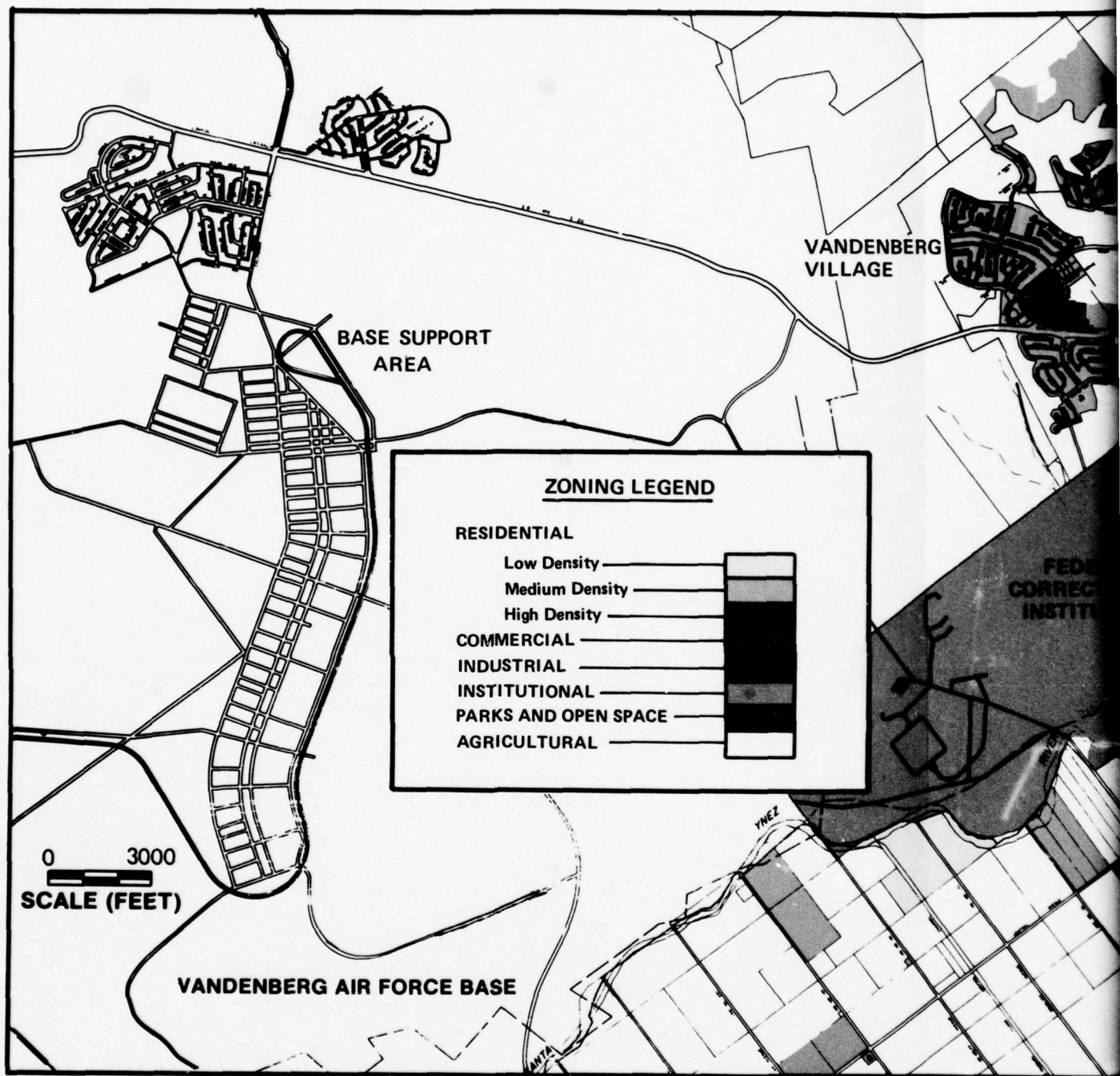
In addition to zoning, Lompoc also endorses the use of the Environmental Resources Management Element (ERME) which sets forth environmental concerns and constraints to be taken into account when land is developed. It attempts to identify the broad type of activities appropriate or suitable on land within the city and in the vicinity.

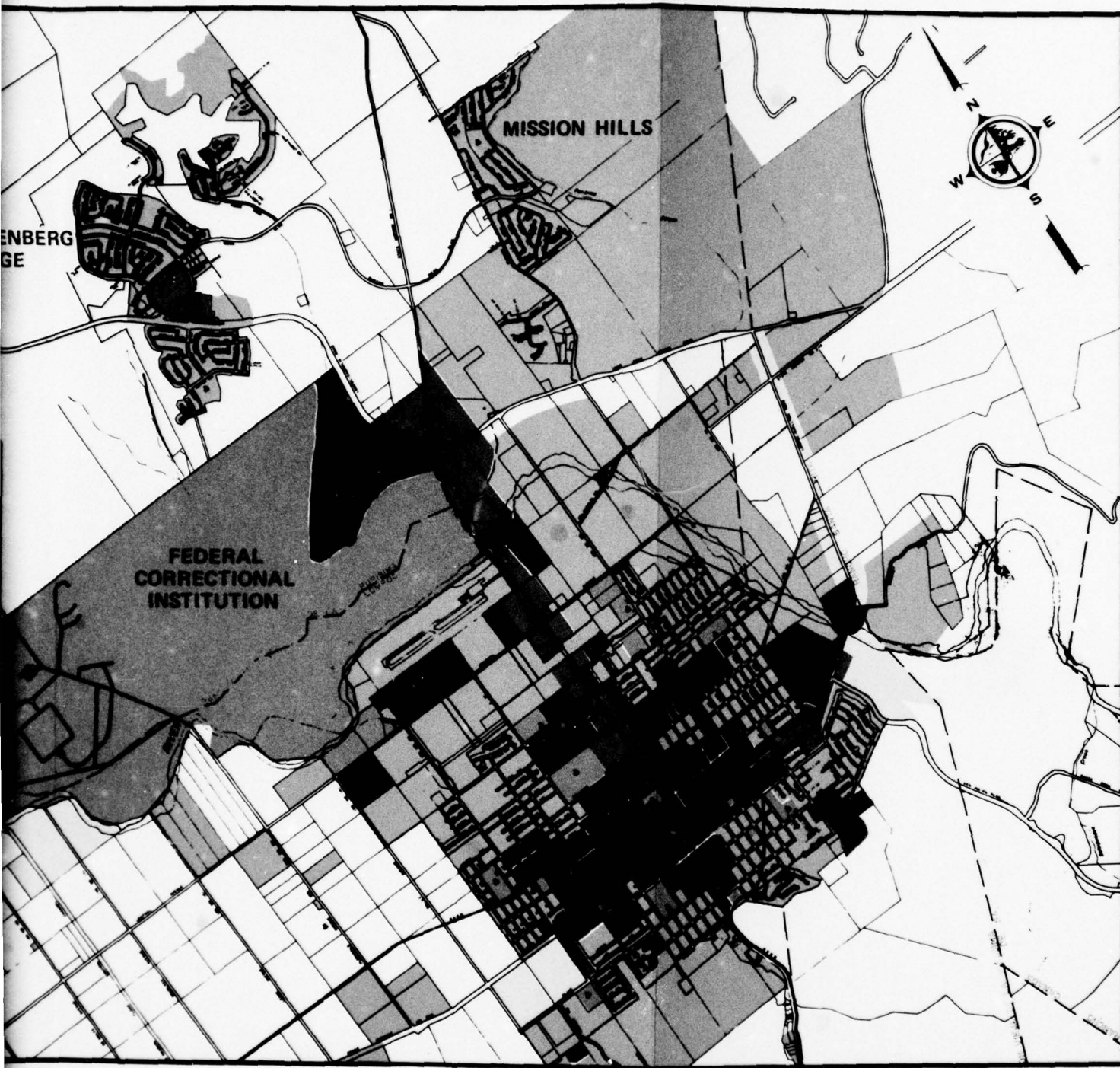
According to County and City General Plan maps, most future residential development in the Lompoc vicinity should infill existing urbanized areas, both within bordering Lompoc and Vandenberg Village. The City of Lompoc is currently advocating before the County Local Agency Formation Commission that Vandenberg Village and Mission Hills be included within the City's "Sphere of Influence", an area designated by LAFCO for planning purposes, but without any definitive fiscal or regulatory significance. The City is also studying the feasibility of providing urban services to an unincorporated area between Mission Hills and Vandenberg Village at the intersection of Highway 1 and County Road S-20. There is also a proposal to annex an area between Lompoc and the Santa Ynez River and immediately east of the River, including a City park. The City's



372P-897-1

Figure 2-9. Area of proposed rezoning, Lompoc Valley (Santa Barbara County Planning Department, 1978).





372P-469

Figure 2-10. Zoning for the city of Lompoc and surrounding area (City of Lompoc Community Development Department, 1975).

Missile Flight Testing III-219

Table 2-3. Net zoning area in the Lompoc vicinity.

ZONING CATEGORY	DESCRIPTION	NET ACREAGE	NET HECTARES
RA	Residential Agriculture	116	46
R-1	Single Family Residential	1,109	444
R-2	Duplex Residential	117	47
R-3	Multiple Family Residential	247	99
T	Mobile Home Park	32	13
PD	Planned Development	7	3
CO	Commercial Office	19	8
CC	Convenience Center	5	2
C-2	Central Business	114	46
PCD	Planned Commercial	130	52
CM	Commercial Industrial	117	47
PM	Planned Manufacturing	151	60
OS	Open Space	460	184
PF	Public Facilities	3,072	1,229

372T-3033

Source: City of Lompoc Community Development Department, 1975.

current policy is to expand gradually to the north in a controlled manner consistent with sound economic objectives.

Major open space designations are located east and west of Route 1 between Lompoc and Vandenberg Village. Industrial development is slated for the intersection of Routes 1 and 246 and also south of the Lompoc Airport. Commercial growth will concentrate along intersecting Ocean and "H" Streets. The preservation of agricultural lands east and west of Lompoc is also indicated on the maps. (Santa Barbara County Planning Department, 1977j).

Present Land-Use--Santa Ynez Valley (2.2.2.4). The Santa Ynez Valley is an unusual area that is neither actually urbanized nor strictly rural. Figure 2-11 depicts zoning in the Santa Ynez Valley. Agriculture holds the largest share of zoning in the valley—267,000 acres (106,800 ha)—with minimum lot sizes from 10 acres (4 ha) to 100 acres (40 ha). With the adoption in 1977 of a rezoning of the Santa Ynez Valley, continued urbanization of much of the area has been restrained.

Residential zoning occupies the second largest acreage, 4,700 acres (1,880 ha). Residential zoning, in general, clusters around the tourist communities of Buellton and Solvang, and the towns of Santa Ynez, Los Olivos, and Ballard. However, occasional clusters of large-lot residential zoning fill in the area between Solvang and Santa Ynez, and occupy "island" areas to the north and east of Santa Ynez.

Some light industry both exists and is planned for in the Santa Ynez Valley. The largest areas slated for industrial expansion are located in the southern and northern ends of Buellton, the southwest corner of Solvang, and near the Santa Ynez Airport. Industrial zoning amounts to about 180 acres (72 ha) (Santa Barbara County Planning Dept., 1977h).

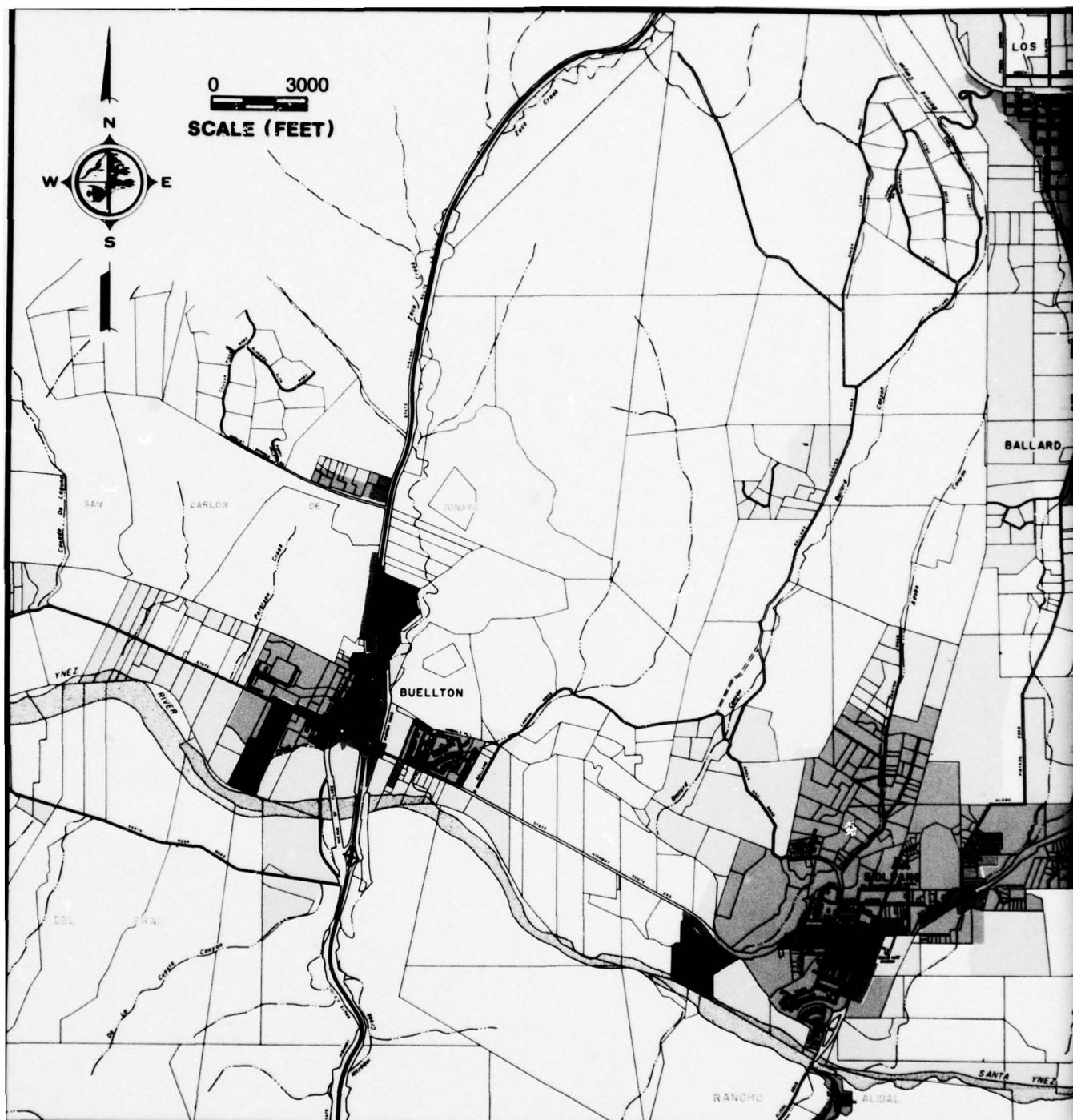
County development is generally planned for the centers of communities in the valley, and the acreage zoned for these areas totals 430 acres (172 ha) (Santa Barbara County Planning Department, 1977h). The commercial area of Buellton especially is projected to increase, signifying its importance as a travel stop for traffic on U.S. 101 (Santa Barbara County Planning Department, 1977h).

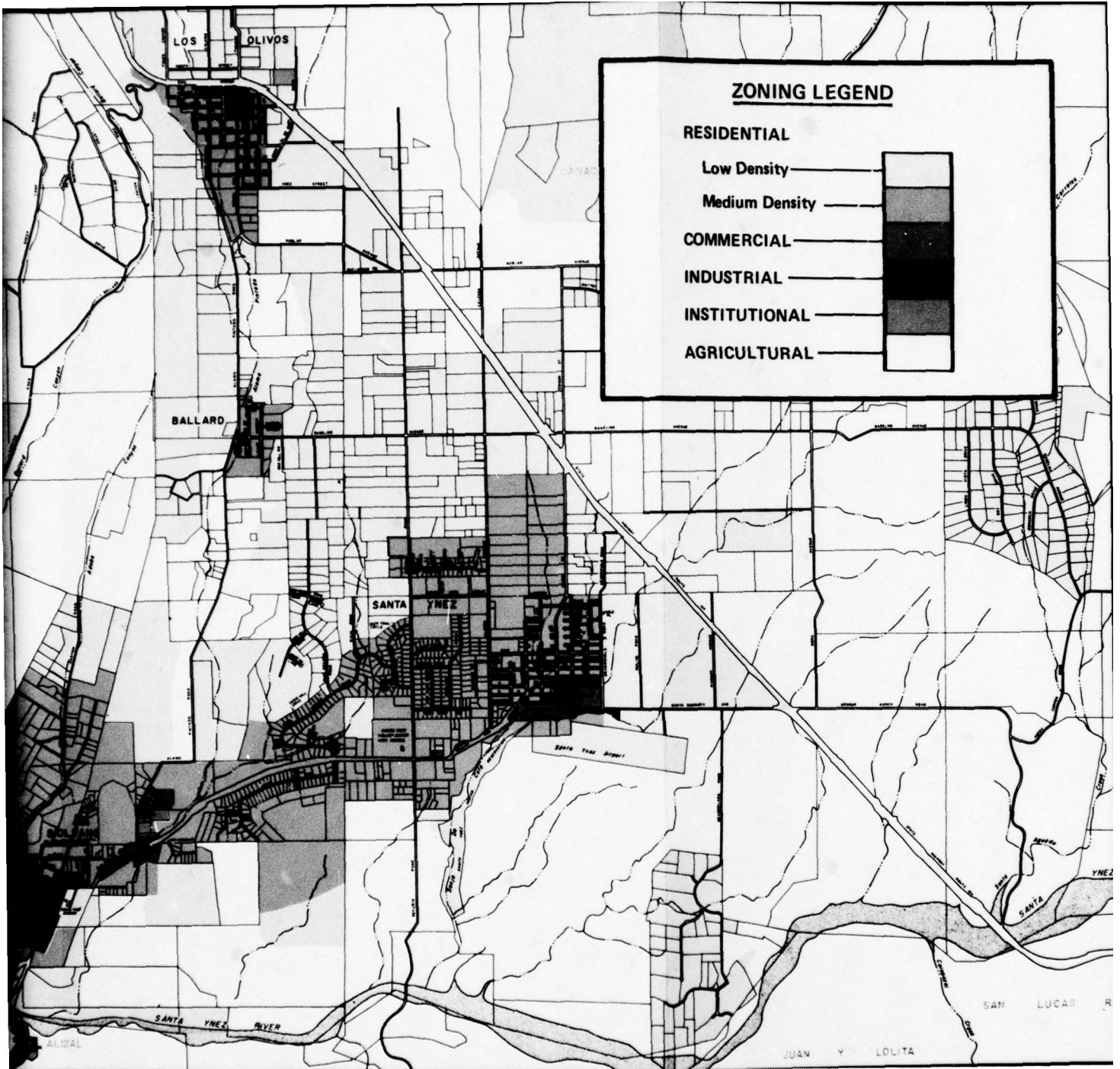
Onbase Land Use Plans, Policies, and Controls (2.2.3)

Land use on Vandenberg is controlled by the Comprehensive Plan, a classification (zoning) system for the military use of land, and Air Force environmental regulations.



The Santa Ynez Valley has long been a favorite place to raise and ride horses and the prevalence of large lot zoning supports the retention of equestrian sports.





Base Master Plan (2.2.3.1). The Comprehensive Plan is a document which describes and maps the existing natural environment, facilities, and socioeconomic characteristics, as well as the future development of the base. The first section, or "TAB" of the plan, is an extended narrative describing the natural and socioeconomic setting of the base and surrounding area. Some description of military activities and units resident on the base are also provided in TAB-A. TAB-B, -C, and -E are devoted to maps which cover the entire base and graphically depict the regional location, existing roads, airfield facilities, geological information, and cantonment facilities. TAB-D provides summary meteorological data. TAB-F graphically indicates, on a series of maps, future development plans through the year 1980. The end of the TAB-A narrative discusses the new facilities and proposed changes in military land uses depicted on TAB-F maps.

The Future Development Plans in TAB-F indicate what new construction or changes in existing facilities have been authorized. Any changes in these plans require that a site plan or a proposed action be approved in turn by the Base Commander, the Base Facilities Board, the Division Commander, and the Strategic Air Command (SAC) in Omaha, Nebraska (Vandenberg AFB, 1978). The disposition of facilities as specified in the plan was based on the desire to maintain an equilibrium between the three proposed military land uses. The military land uses include launch areas, technical support areas, and base support areas. The major points considered are:

- maximum flexibility of use
- expansion capabilities
- efficient use of terrain and utilities
- noise, hazards, and other disturbances
- efficient movement of vehicles and pedestrians

The changes proposed in TAB-F are scheduled according to the three military land-use areas. In the launch areas, Space Shuttle facilities are projected to be built along the southern coast of Vandenberg and the impact limit line for launches has been recommended to extend farther east and south. This will allow for greater flexibility in the amount of land available for launches and in the restrictions on all launch facilities.

In the base support area, continued relocation of facilities in the southern cantonment area is stressed to allow for the approach zone to the airfield. All future family housing is recommended for the area northeast of Lompoc-Casmalia Road. Existing motor pool and warehouse facilities built in 1942 are scheduled to be replaced.

Buffer zones of at least 10,000 ft (3,048 m) currently exist between launch sites. As new boosters generating higher noise levels are launched, there will be a need to increase the distances between launchpads in the

technical support areas. Also, guidance, tracking, and storage facilities will be relegated to areas such as the mountainous regions of Point Sal and South Vandenberg and the Santa Ynez River area.

In offbase areas, TAB-F recommends that the Southern Pacific Railroad lines be relocated outside the base, and that evacuation agreements for Ocean Beach, Jalama Beach, and Point Sal Beach be maintained. Relocation of the railroad line is not anticipated in the foreseeable future.

Onbase Land-Use Zoning (2.2.3.2). Proposed military land uses for Vandenberg rest on the primary function of the base as a missile launching and testing site. As Figure 2-12 illustrates, these land uses are broken down into three categories: launch areas, technical support areas, and a base support area. Launch areas are located along most of the Vandenberg coastline, and only military facilities and activities directly applicable to launch functions are allowed. Lands designated as base support are located in and adjacent to the cantonment and base housing areas. This area contains those facilities necessary to feed, house, and entertain military personnel and their families. At its closest point, this area is 8,000 ft (2,438 m) from launch areas. The technical support areas occupy lands that buffer launch areas from the base support area. In addition, lands devoted to technical support also act as a buffer zone between the base boundary and the launch areas. In general, technical support areas provide open space between launch sites and populated areas or they occupy lands which are not available for development because of their topography or geology.

All these land use areas incorporate nonmilitary land uses. Recreational sites are scattered throughout the northern part of the base and hunting areas are found in both the north and south portions. Grazing and field crop leases have been approved in both launch and technical support areas. This mixture of land uses has not interfered with the military requirements of the base, and, in the event of a conflict between uses, military land uses would take the highest priority.

Environmental Protection Regulations (2.2.3.3). The acquisition of the base by the Army in 1941 and the safety requirements of the current missile launching programs have substantially limited public access and development at Vandenberg. As a result, much of Vandenberg is a unique, relatively preserved natural area of special interest biotic communities and undisturbed archaeological deposits. Efforts are made to simultaneously preserve this environment and to accommodate the military mission of the base. All base environmental documents provide inventories of existing resources, establish procedures for maintaining them, and are a key component in the process of assessing the environmental impacts of actions on Vandenberg.

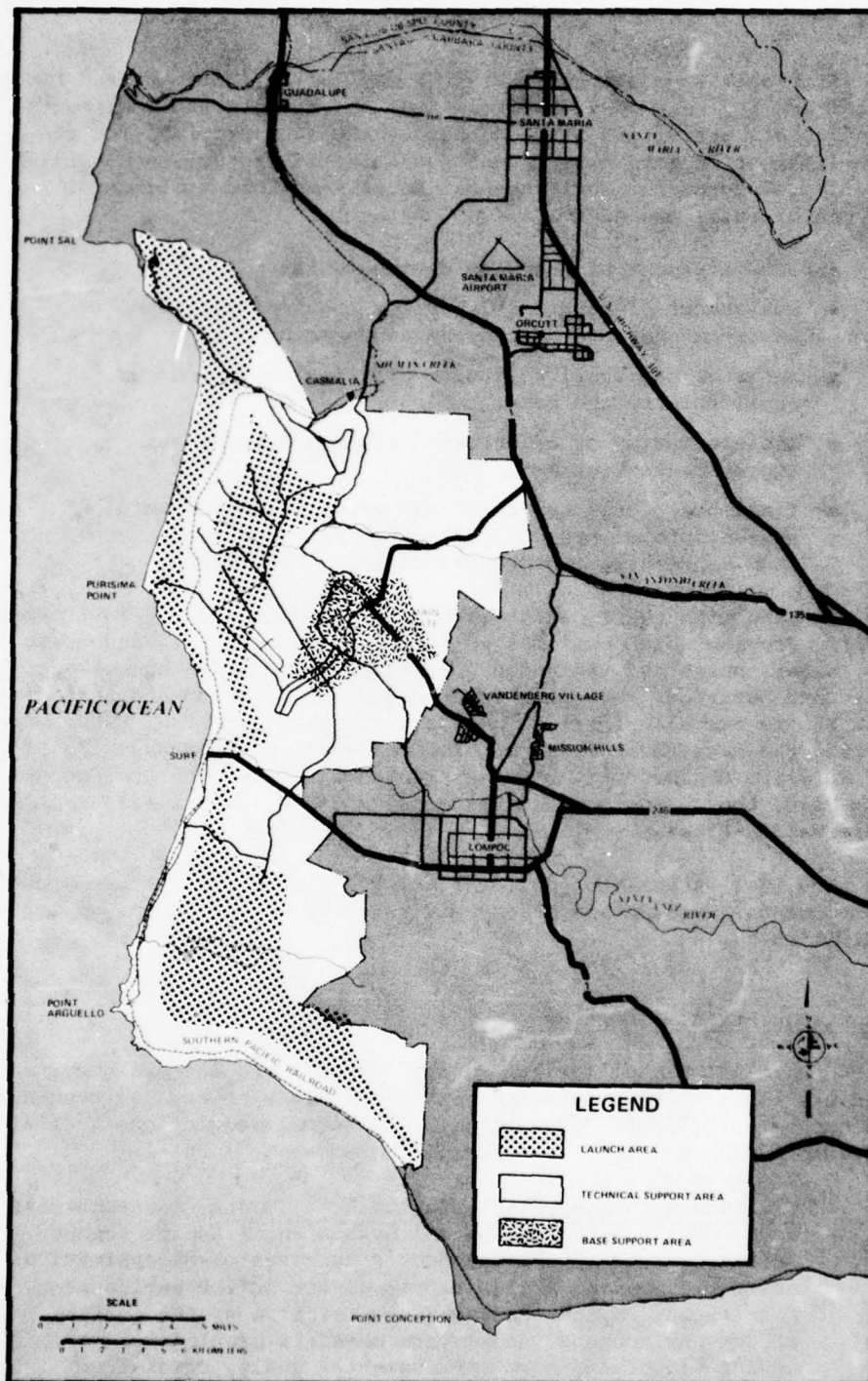


Figure 2-12. Vandenberg AFB land-use zoning (Vandenberg AFB, 1977).

Air Force Regulations (AFR) 19-1 (Pollution Abatement and Environmental Quality) and 19-2 (Environmental Assessments and Statements) apply to all activities at Vandenberg. AFR 19-1 provides for the establishment on each base of an Environmental Protection Committee (EPC) and of procedures for environmental assessments and statements. Responsibilities include:

- establishment of basewide environmental policy
- assignment of responsibility for the implementation of environmental protection and enhancement
- enforcement of all pollution criteria and standards applicable to the base
- implementation of effective pollution control and improvement programs
- final base-level review of all written environmental assessments of projects affecting the base and originating from Vandenberg tenants (Vandenberg AFB, 1971a).

In line with their mandate, the EPC has completed an *Environmental Quality Program* which outlines policies and controls at Vandenberg for air, water, noise and radiation pollution, solid waste management, and toxic and hazardous materials management. Other documents that are part of the overall effort to maintain the environment of Vandenberg include the *Management Plan for the Conservation and Management of Fish and Wildlife Resources*, the *Forest Management Plan*, the *Grazing Management Plan*, the *Outdoor Recreation Plan*, and the *Natural Resources Conservation Program*.

AFR 19-2 establishes policies and guidelines for the preparation of environmental assessments of any Air Force policy, program, or continuing activities.

Other Regulations Affecting Land Use (2.2.4)

General Plans and zoning are the foremost regulations governing land use and directing local governmental policy toward environmentally and economically sound development. Additional regulations that affect land use in the Base Environs are given below:

- California Environmental Quality Act (CEQA). Environmental assessment is detailed in an environmental impact report (EIR) prior to a public agency's approval or disapproval of activities having a significant effect on the environment. Significant impacts include: restriction of the quality of the environment, short-term benefits precluding advantageous long-term environmental goals, cumulative

project impacts, and substantial adverse effects on human beings. These factors are all considered prior to project approval and if impacts are severe, mitigative measures or project denial may result. This state act is generally similar to this EIS required under federal regulations.

- California Coastal Commission. The California Coastal Commission's charter is "to preserve the ecological balance of the coastal zone and prevent its further deterioration and destruction". Developments in all lands and waters within the jurisdiction of the commission, must also conform to the numerous policies set forth in the California Coastal Act. Figure 2-13 indicates the area along the central coast included within the coastal zone. The Coastal Commission

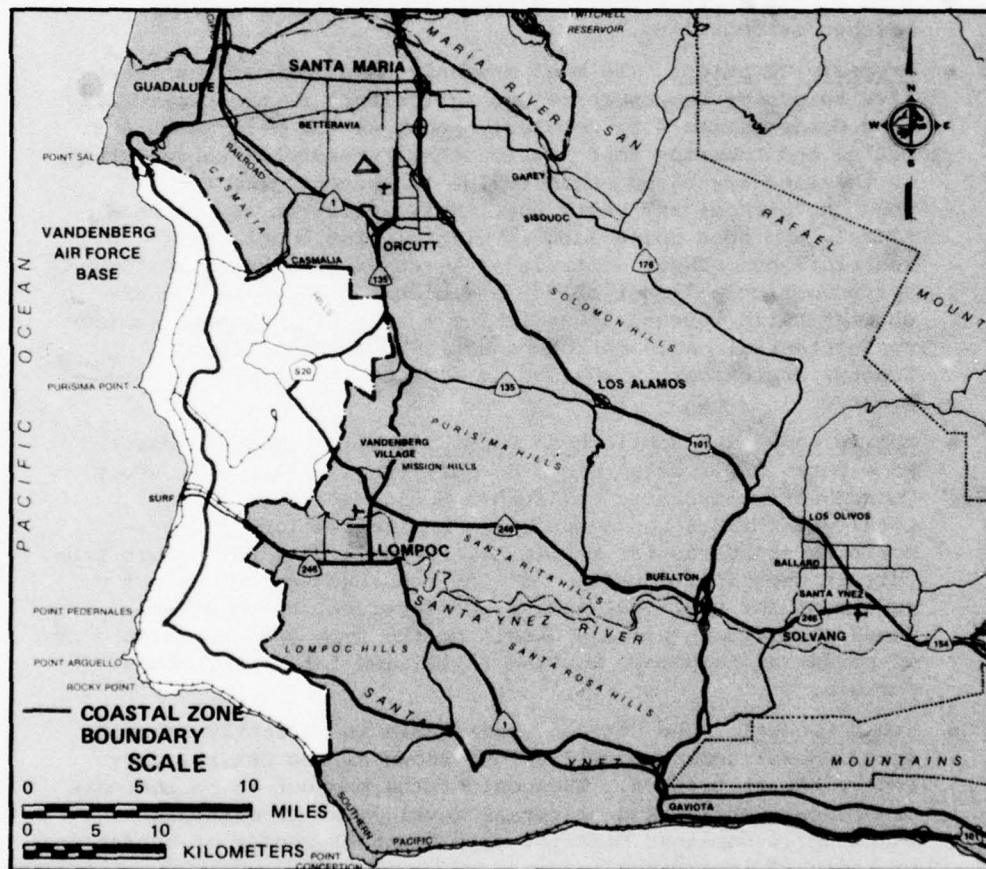


Figure 2-13. California coastal zone, central coast (California Coastal Commission, 1977).

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has no jurisdictional authority over federal land; thus, its policies do not legally apply to the future development of Vandenberg. However, proposed federal coastal regulations state, in part, that:

Each federal agency conducting or supporting activities directly affecting the coastal zone shall conduct or support those activities in a manner which is, to the maximum extent practicable, consistent with approved state management programs (*Federal Register*, 1977).

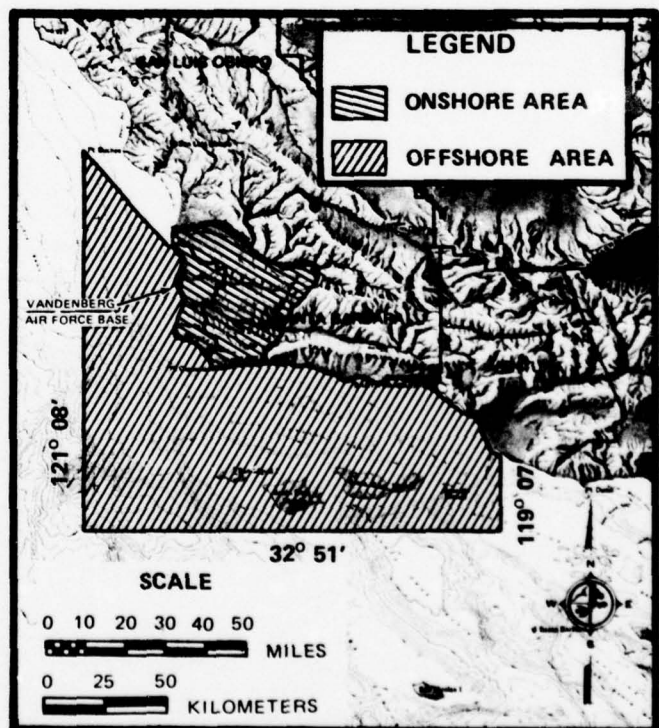
- Subdivision Regulations. Cities and counties may attach many conditions to subdivision approvals including land or fees which are used to defray the costs of development otherwise imposed on the community as a whole and dedication of "reasonable public access" to government-owned beaches or shoreline.
- Property Taxation. The most commonly used form of tax incentive to preserve open space and agriculture is the California Land Conservation Act, popularly known as the Williamson Act. Cities and counties form "agricultural preserves" where taxes on the land are based on the value in present use, rather than on "highest and best" use. Only agricultural, recreational, and open space land is eligible for contractual restrictions. These contractual arrangements, known as "Open Space Contracts," must be for a minimum of 10 years and are automatically renewed annually for a term of 10 years, subject to substantial cancellation penalties. In Santa Barbara County, approximately 494,000 ac (197,600 ha) are under the program.
- Mobile Homes and Mobile Home Parks. Mobile homes and mobile home parks are regulated by the California Health and Safety Code (*West's Annotated California Health and Safety Code*). Local governments can adopt rules and regulations for prescribing standards for mobile home park layout, for prohibiting certain uses in the parks, and for construction and use of equipment for public utilities and services, among others. These regulations place controls on the type and expansion of potential temporary housing facilities for construction workers.
- Urban Renewal. The city of Santa Maria is currently engaged in a federal urban renewal effort known as the Central City Redevelopment Project. The goal of the project is to recreate or preserve office and/or retail development to maintain the Central Business District as a business center of subregional or regional importance.
- Santa Barbara County-Cities Area Planning Council (APC). The APC has the power of regional review over federal grant applications by local jurisdictions in order to promote local

conformity to regional or areawide planning. Aside from the 61 special districts in the county, other special purpose units of government within the jurisdiction of the APC are Vandenberg Air Force Base, the University of California at Santa Barbara with the Regents of the University as the governing body, the California Department of Transportation District 5, the Regional Water Quality Control Board, and the South Central Air Quality Resources Board (Santa Barbara County-Cities Area Planning Council, 1974). The APC, the State Office of Planning and Research (OPR) and Vandenberg have a memorandum of understanding on matters of mutual concern.

The Agreement of Understanding is an instrument to assure the passing of information on plans and projects of mutual concern between the Air Force, the State Clearinghouse (Office of Planning and Research) and the areawide clearinghouse (S. B. County-Cities Planning Council). The agreement also includes two maps which define the areas of concern; they are combined and shown in Figure 2-14.

Nothing in the agreement gives any party a veto power over the decisions or actions of any other party. With regard to MX, the agreement requires that the Air Force notify the clearinghouse

Figure 2-14. Areas of mutual concern between Vandenberg AFB and the Santa Barbara County-Cities APC (Santa Barbara County-Cities Area Planning Council, 1974).



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of the proposal, requires the clearinghouse and the area planning council to respond, if they desire, within 60 days after notification by the Air Force, and requires the Air Force to respond to any questions raised by those parties.

- Santa Barbara Local Agency Formation Commission. Local Agency Formation Commissions (LAFCOs) review most local governmental structural changes, including incorporations and disincorporations, special district formations, dissolutions, annexations. At the present time, LAFCO has designated two "spheres of influence" in the county—the city of Santa Barbara and the city of Santa Maria (Santa Barbara County Local Agency Formation Commission, 1977). Future requests to have land outside this sphere of influence boundary included within the cities' boundaries or serviced by some special district, such as a water or sewer district, will be subject to a vote of the LAFCO membership. If a commitment exists on the part of the LAFCO members to discourage development outside the sphere of influence, service extensions could be denied. Development within the sphere can proceed without such review.

2.3 PROPOSED ACTIONS AFFECTING LAND USE

Besides established planning policies and regulations, there are currently other proposed actions affecting land use which could influence or be influenced by the MX program. Major foreseeable events within the county which would likely have an affect include the Space Shuttle program at Vandenberg, and the possibility of a liquefied natural gas (LNG) terminal along the coast of Santa Barbara or San Luis Obispo counties.

Space Shuttle Program (2.3.1)

The National Aeronautics and Space Administration (NASA) and the Department of Defense are collaborating to produce a new space vehicle with a larger transport capacity that is capable of returning to earth and relaunching. This project, known as the Space Shuttle, will be launched from Vandenberg on the west coast and from the Kennedy Space Center on the east coast. Construction of the necessary facilities at Vandenberg is scheduled to begin in April 1979. Flights from Vandenberg are expected to begin in June 1983.

Because construction and operation schedules related to the Space Shuttle program are likely to overlap with construction and testing schedules of the MX program, the cumulative effects of both programs as they occur simultaneously or consecutively will be important. Figure 2-15 indicates the locations of the MX candidate siting areas and the Space Shuttle facilities at Vandenberg. A proposed Titan III storage facility is also indicated as the Space Shuttle program necessitates its relocation.

Proposed Liquefied Natural Gas Terminal (2.3.2)

Efforts are underway to find a suitable site along the California coast to locate a liquefied natural gas (LNG) terminal. Such a terminal would receive LNG transported by ships from Indonesia and Alaska, unload and transfer the LNG into storage tanks, regasify it, and deliver natural gas to users via transmission pipelines (California Coastal Commission, 1977).

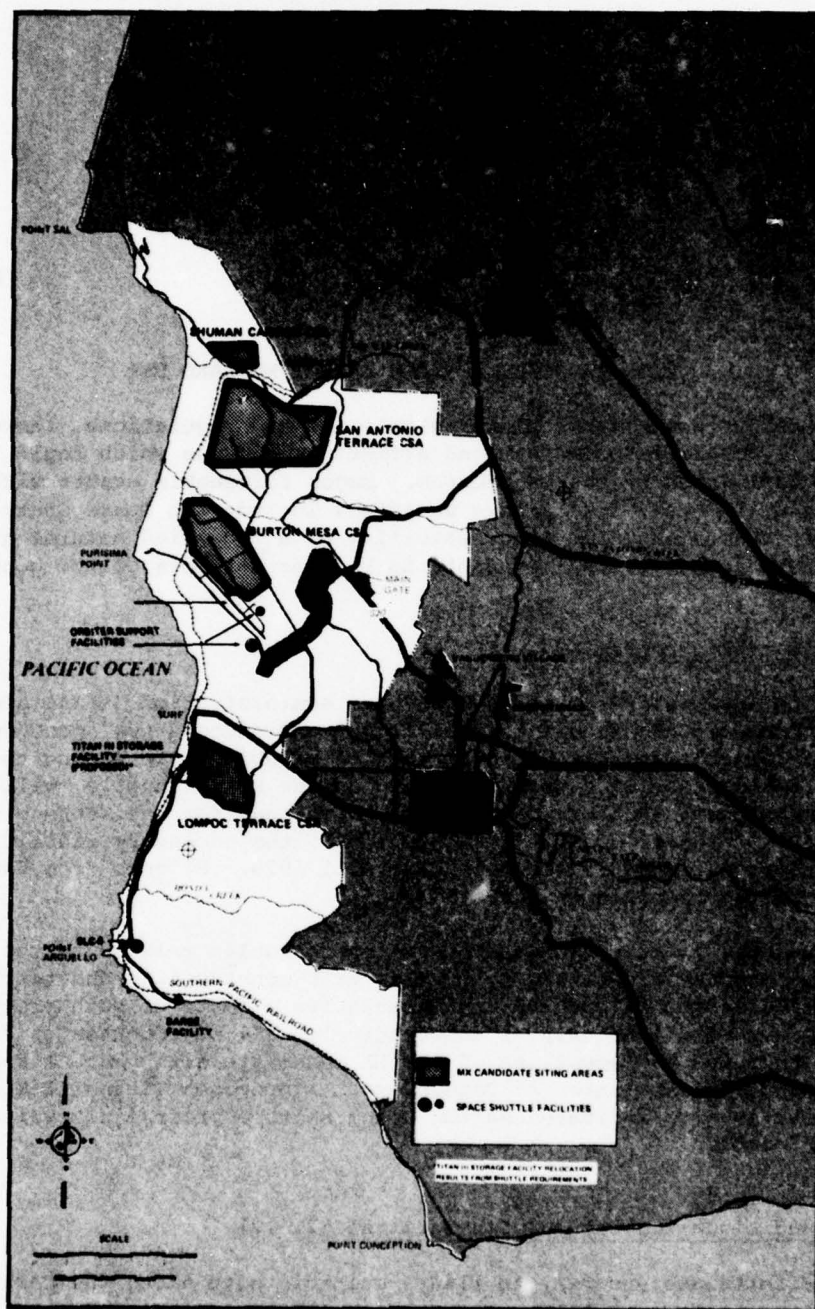


Figure 2-15. MX candidate siting areas and proposed Space Shuttle facilities at Vandenberg Air Force Base.

The Liquefied Natural Gas Terminal Act of 1977 requires that a site remote from population centers be selected and that a previously studied site near Point Conception be among the final ranking submitted by the Coastal Commission to the Public Utilities Commission. A second site, in Santa Barbara County at Las Varas Canyon, and a third site at Rattlesnake Canyon in San Luis Obispo County, are also among the sites to be considered. Figure 2-16 indicates the locations of these three proposed sites. Their proximity to Vandenberg and the construction requirements of such a project indicate that some cumulative impact on the Vandenberg area and on the MX and Space Shuttle programs themselves could occur, especially during the terminal's construction phase.

Two 550,000 barrel (87,450 m³) storage tanks and a vaporization plant used to convert the liquefied fuel to a gas as well as marine berthing and unloading facilities located about 4,000 ft (1,219 m) offshore would be required. LNG will be transported to the site in ships with a cargo capacity of about 34,320,000 gal (130,000 m³). About 193 LNG tanker arrivals a year are expected at the terminal. From the terminal, the gas will be transmitted by a new pipeline to Gosford, California, south of Bakersfield, for distribution (Western LNG Terminal Associates, 1977).

A peak labor force of approximately 1,500 persons will be required to construct the terminal and another 450 will be needed to complete the overland pipeline to Gosford. A total of 50 people will operate the terminal and no more than 6 will be needed to control pipeline operations (Southern California Gas Company, 1977). It is unknown at this time whether the presence of such a facility would encourage the development of associated industries in the area, and if it did, how the Coastal Commission would view such development.

Other Future Developments (2.3.3)

In the Santa Maria-Orcutt area, Knollwood, a 225-unit mobile home park and 8,000 ft² (2,438 m²) office building, has been granted an extension until December 1978 to allow for the incorporation of revisions. Plans for 79 apartment units on 13.67 acres (5.5 ha), known as South Points Apartments and located north of Rice Ranch Road near Orcutt, has been approved by the Santa Barbara County Planning Commission. A small 61-unit addition to the existing Orcutt Ranch Mobile Home Park is being considered by the same body (Santa Barbara County Planning Commission, 1977a).

In Buellton, the Ventura International Corporation of Oxnard was denied a General Plan change to develop a 200-space mobile home park on land currently zoned Highway Strip Commercial and Industrial. This decision is being appealed (Santa Barbara County Planning Department, 1977a).



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Figure 2-16. Potential LNG terminal sites proximal to Vandenberg.

III-236 Missile Flight Testing

In the Vandenberg Village area, Oakhill Cluster, a 47-unit development on 10.3 acres (4.1 ha), has received Planning Commission approval. Other developments in the area are awaiting decision. Groundwater overdraft has become an issue during hearings on most developments in this area. The Santa Barbara County Water Agency states that groundwater in the Lompoc/Vandenberg Village area is being overdrafted by 3,000 acre-ft ($3.7 \times 10^6 \text{ m}^3$) per year. However, local agencies claim that recent conservation measures have reduced the amount of overdraft. The consequential point is that overdraft and new development cannot both continue indefinitely. Either supplemental water or increased conservation will be required or the rate of growth will slow to near zero.



Environmental Impacts

3

ENVIRONMENTAL IMPACTS OF THE PROJECT

The environmental impacts associated with missile flight testing as part of the overall full-scale development program will be felt in three specific areas:

- Candidate siting area: Site-specific impacts; typically topographical, biological, and archaeological.
- Base and environs: A continuation of economic and traffic impacts, including alteration of existing base operations.
- Countywide: Chiefly socioeconomic, including stimulated growth and economic impacts in Santa Barbara County.

Each of the four candidate siting areas described in Section 1.1.4 is treated in equal detail; and, where appropriate, the differences between the discrete and continuous aimpoint basing mode options are compared for each candidate siting area.

In addition, the specific impacts will be felt in separate program phases, construction phase and operations phase. The construction phase is scheduled to begin in 1981 and last 2 years. The operations phase will begin in 1983 and last approximately 4 years. The Strategic Air Command training and testing phase will begin during the operations phase and last an indeterminate period.

This environmental impact analysis addresses the physical, biological, and socioeconomic impacts which may occur during the construction and the testing (or operations) phases of the MX test program at Vandenberg. The basing mode option and the candidate siting area which are ultimately selected for development at Vandenberg will be major factors governing the magnitude of those impacts which are highly location-dependent, such as topography, noise, biology, traffic, and archaeology.

Construction of MX facilities at Vandenberg will cause adverse and beneficial impacts of both short-term and long-term duration. The effects of the construction effort (earth moving, vehicular traffic, creation of jobs, etc.) occur during a relatively short period of time (\approx 2 years). However, the impacts on the environment of such project effects may or may not be confined to the duration of the construction activity. For example: dust from excavation, pollutants and noise from construction vehicles and machinery, and construction jobs will be short duration; while the alteration of topography, the loss of or damage to biotic communities or archaeological sites, and the indirectly induced population growth with its attendant demands upon community infrastructure will be long-term or even permanent impacts.

Operation of the MX test facilities at Vandenberg will cause both adverse and beneficial environmental impacts of varying durations. Some impacts, such as noise from missile launches, will be intense but occasional and of brief duration. Other impacts, such as increased employment, will last for the lifetime of the project. Also, indirect impacts which influence population growth may have long-term implications for demands upon community infrastructure, such as water supply, wastewater treatment, and energy supply.

3.1 IMPACTS AT THE CANDIDATE SITING AREAS

This section discusses the impacts of MX facility construction and operations to the project site and its vicinity. Impacts that vary little with selection of candidate siting area are discussed in Section 3.1.1. More site-specific impacts, primarily construction related, are discussed in Section 3.1.2. This arrangement of topics is designed to emphasize the environmental considerations of greatest importance in site selection.

Impacts Shared by the Candidate Siting Areas (3.1.1)

Construction Impacts (3.1.1.1)

Topography (3.1.1.1.1). Construction of the proposed test facilities would have direct and indirect effects on the topography of the individual CSAs. The direct effects would include modification of the land surface due to construction of access roads, rail transfer facilities, buried trenches or shelters. These facilities would require cutting hills and filling lows in existing topography to achieve the proper design grades at the candidate siting areas and access routes to them. The alteration of the natural contours of the land surface could be objectionable on an aesthetic basis, but could be mitigated by careful planning. This would include designing the layout of test facilities to be compatible with the existing land surface, using a balanced cut and fill plan, and recontouring after construction. Indirect effects are reflected in changes of the land surface and drainage patterns in response to direct land modification and relocation of drainages. The changes could cause increased wind and water erosion, gullying, stream siltation, wind generated dust and alteration of the existing stream draining patterns. All of the planned actions which modify the landscape would leave long-term topographic impacts which would not recover during the life of the project and might not be restored at the end of the project.

Paleontology (3.1.1.1.2). Paleontological interests may be uncovered during excavation and grading for construction. No known paleontological sites exist at any of the candidate siting areas; however, many of the formations underlying the areas do contain some fossils. The fossils, primarily microfossils, present are not unique and are widespread throughout the region. The impact of construction on paleontology at each of the candidate siting areas will be minimal.

Geologic Hazards (3.1.1.1.3). Vandenberg is subject to a number of potential geologic hazards. Seismic impacts include ground rupture, ground shaking, tsunamis, soil liquefaction, and landslides. The potential

for severe seismic shaking due to movement along the offshore Hosgri fault, or along other active faults, is a major hazard at all CSAs. Tsunami flooding would not be a hazard as the CSAs are located on the terrace surface above areas that possibly could be inundated. Soil liquefaction is possible, particularly if an earthquake of any consequence should strike during, or following, a period of heavy rainfall. All the CSAs on Vandenberg except, perhaps, Shuman Canyon where rock lithology lends itself less to this hazard, are susceptible.

Soils (3.1.1.1.4). Most soils would be disturbed, buried, or removed during the construction phase in the immediate vicinity of planned facilities. Generally, the soils at Vandenberg consist of sand and silt that is readily erodible if not protected by vegetation or controlled drainage. The soil cover most sensitive to disturbance by excavation or traffic is on stabilized dunes covering most of the coastal area. The soil there is poorly developed and is stabilized only by a fine, interlocking root network that helps resist wind erosion. Removal or disturbance of the root network will make available all the underlying sand to wind erosion, causing blowouts and reactivation of the sand dunes. To avoid the most adverse effects of soil disturbance and erosion, the facility layouts will be located away from stabilized dune areas. Vegetation of exposed granular soils would be restored in accord with sound grading practice.

Impacts of soils conditions with regard to engineering relevance on the project are difficult to assess until specific site studies are undertaken. However, it is estimated that the Shuman Canyon CSA is the only area with any appreciable possibility for expansive soils. The San Antonio, Burton Mesa, and Lompoc Terrace CSAs contain very similar soil properties that trend toward compressibility, especially in the stabilized and unstabilized sand dune areas. Increased compressibility of the Orcutt Formation could be induced by the infiltration of water above normal, as in the case of changing levels in the perched groundwater table that exists at San Antonio Terrace and Burton Mesa CSAs.

Hydrology (3.1.1.1.5). Construction of a test facility for the MX program at Vandenberg would result in a number of impacts on surface hydrology and water quality. While these impacts would be limited, from the comparatively small scale of the test site, they could serve as a rough index of the impacts to be expected during full-scale deployment.

The construction water supply requirements are estimated to average 20 gallons (0.08 m³) per minute for a 6-month period. It is anticipated that this water will be obtained from San Antonio Valley, Lompoc Valley, and/or the Lompoc Terrace aquifers.

Water Quality (3.1.1.1.6). Construction activities at Vandenberg will not significantly affect groundwater but may influence natural surface water quality in contiguous and nearby drainages in several generally nonsite-specific ways. Most impacts may occur during heavy rain when soils and material exposed by removal of natural ground cover, excavations and unprotected stock piles are eroded into drainage channels. Corrosion of exposed metal works could further add constituents to surface waters during rain.

The clearing of natural vegetation and construction of roads, buildings, launch sites, etc., may contribute to the sediment load in runoff during rainfall, thereby temporarily increasing turbidity in some water bodies and tributaries near the Shuman Canyon, Burton Mesa, and Lompoc Terrace CSAs. The increase in runoff would result in higher flowrate downstream of the construction site. However, since the construction site is extremely small compared to the entire watershed, the increase in runoff is not considered to be significant. Prospective San Antonio Terrace construction sites, however, are situated where runoff into any surface water bodies is unlikely. Increased turbidity will not prohibit livestock watering, irrigation and warm water fish and wildlife rise since turbidity is not a limiting criteria for these beneficial uses. All CSA construction sites are remote enough from oceanic habitats so that water clarity will not be affected.

No major impact to water quality is expected from cement utilization. A minor source of this contamination may result from cleanup activities and elution of cement production materials into nearby waterways. Turbidity due to cement compounds will increase slightly during runoff, but should be considered negligible and transitory in comparison to natural sediment erosion into the well-buffered streams and ponds of the area.

Runoff of various other constituents from construction activities might be expected also. For instance, iron and other metallic oxides from exposed iron works and reinforcements may wash into the streams and ponds during rainfall. Spilled oils and other hydrocarbons hazardous to beneficial water uses may also wash into surface waters periodically.

Use of surface or groundwater for irrigation will be unaffected by construction activities as no salt or boron ingredients will be susceptible to spills or leakage.

The volume of treated wastewater discharged from the Lompoc Regional Wastewater Reclamation Plant into the Santa Ynez River will not increase measurably as a result of MX construction—induced direct and indirect population growth in the vicinity of Lompoc and other areas tributary to the Lompoc plant.

Biological Impacts (3.1.1.1.7). Construction of MX test trenches or shelters and required support facilities will impact the biological environment primarily through habitat disturbance or removal. The magnitude of construction impacts upon the terrestrial biological environment depends, in an important way, upon the nature of the habitat disturbed by MX activities. Three considerations are important relative to the impact of habitat disturbance:

- The degree of existing disturbance in the habitat: is the habitat pristine or highly disturbed.
- The local and regional extent of that habitat type: is comparable habitat common and widespread or local and unique.

- The dependence of threatened, endangered, or protected species upon that habitat.

Candidate siting areas on Vandenberg involve habitat types that range from unique, pristine habitats upon which rare species of plants potentially protected by law are dependent, to common, widespread disturbed habitat types upon which endangered species are not dependent.

Vegetation. The major impact of construction of MX test facilities upon the vegetation is expected to be the temporary or permanent removal of native vegetation and loss of habitat. Increases in the ruderal, or weedy, vegetation on Vandenberg both in areas where vegetation has been cleared and where it has been inadvertently disturbed by the action of men and construction equipment is an anticipated secondary impact. Impacts upon candidate threatened or endangered plant species in the form of loss of individuals and loss of habitat are possible in any of the candidate siting areas but are most likely to occur in areas where coastal sage scrub-stabilized dune phase or chaparral are impacted.

Areas covered by paved roads or structures are considered to be permanent loss of habitat; however, substantial areas will have the vegetation removed during construction, but are likely to be allowed to revegetate after construction has been completed. Such areas include fill over buried trenches and road shoulders.

Spontaneous revegetation of areas cleared by MX construction activities will occur at rates and in patterns that depend upon the nature of disturbance, the preexisting vegetation, and the soil type. There is a remarkable lack of published information on pattern and rate of revegetation after clearing for comparable areas in California. Areas of woody chaparral or coastal sage scrub vegetation scraped bare of vegetation may exhibit some resprouting from remaining root systems or burls as has happened, for example, in the chained chaparral areas of Lompoc Terrace. Revegetation of excavated areas (buried trench, pipelines, etc.), however, will necessarily occur from seed.

On all sites, conceptual facilities layouts are primarily located in annual grassland or an annual grassland/coastal sage scrub transition. These types appear to be adapted to and resulting from disturbance and are expected to show relatively rapid post-disturbance recovery. The predicted rapid recovery of this type is based upon the short life-span, copious seed production, and efficient propagule dispersal of the annuals, perennial herbs, and shrubs that comprise this type and from evidence of this type invading cleared areas elsewhere on the base. Only limited areas of other vegetation types would be impacted by construction of facilities as projected in this EIS. These other vegetation types include coastal sage scrub stabilized dune phase, coastal sage scrub-normal phase, and chaparral. Riparian vegetation that is dominated by trees and shrubs depending on near-surface water could be indirectly affected by construction activities.

Plants of chaparral vegetation, although they are notably drought- and fire-adapted, reinvade cleared areas more slowly than plants of annual grassland and coastal sage scrub and recovery to predisturbance chaparral conditions atop trench fill, for example, would be expected to take substantially longer. Nutrient deficient soils with poor physical qualities upon which chaparral commonly grows (as on Burton Mesa) could further slow the process of revegetation. Invading vegetation would initially be composed of annual and weedy herbaceous perennials with weedy shrubs appearing gradually. Certain coastal sage scrub and chaparral species such as mock heather, coyote bush, coastal sagebrush and chamise would eventually invade the area. Fire during the successional process would be required to effect germination of some of the chaparral species. The phenomenon of autosuccession (Hanes, 1971), or "pulse stable" succession (Odum, 1971), typical of post-fire chaparral regeneration, is not expected to occur after clearing.

Recovery to annual grassland, annual grassland/coastal sage scrub, and coastal sage scrub-normal phase would follow the pattern described for chaparral but would occur more rapidly. These types in topographically suitable portions of the candidate siting areas generally occur on friable sandy-silty soil, a type relatively favorable for revegetation.

Riparian vegetation is likely to be affected in limited amounts, if at all, by MX construction activities. This type is composed of species which generally have a broad geographic distribution and which are adapted to repeated natural disturbances such as flooding and realignment of drainage channels. Most species of this type are fast growing, produce copious, mobile seed, and have vigorous means of vegetative reproduction. The limited areas, if any, of riparian vegetation affected by MX construction would be expected to rapidly recover to predisturbance condition within a relatively short period of time provided that soil and water conditions are not appreciably altered.

The stabilized dune phase of coastal sage scrub, unique to the Vandenberg region, is comprised of species which, while many are rare and unique to the area, are adapted to soil disturbances (slowly shifting sand dunes) and should readily reinvade cleared sandy areas. On the other hand, if too much sand is disturbed there is a possibility of reactivating the dune field, an occurrence which would either take a long period of time to rectify by natural processes or would require substantial human intervention, itself not without environmental impacts.

To quantify impacts to different habitat/vegetation types in the four candidate siting areas, conceptual facilities layouts were overlaid on the 1:9600 vegetation maps (Oberbauer, 1976) prepared as part of the environmental planning system. The linear distance of each vegetation type intercepted by the two 2 mi (3.2 km) trenches and the types of vegetation existing at shelter and support facilities sites were determined for each candidate siting area. Nominal areas of each vegetation type impacted

by the project in each candidate siting area were calculated assuming two 2 mi (3.2 km) trenches with an area of disturbance 100 yd (91.4 m) wide (150 acres (60 ha) total) and assuming a total disturbance of 25 acres (10 ha) for three shelters and 30 acres (12 ha) for support facilities. These results are presented in Table 3-1.

Wildlife. The primary impact of construction on resident terrestrial fauna will involve removal of habitat. Such habitat removal will cause loss of "home" range and food resources for some fauna and, depending upon the particular CSA selected, possibly slight and temporary reductions in species diversity and richness. The actual removal of native habitat will be small. Construction activities will be expected to influence wildlife movement. Large wildlife such as deer and feral pigs will generally avoid areas of active construction during the portions of the day that construction work is ongoing. Those animals should readily cross construction zones at other times. Small animals will be prevented from utilizing the construction area during work periods and may cross or forage on the margins during non-work periods. The negative influences of construction on movement are expected to be temporary and to largely end or be greatly diminished when construction itself ends.

After construction, the presence of trenches or discrete aimpoints and associated facilities at Vandenberg are not expected to seriously impact wildlife movement patterns or ability of wildlife to locate food. Roads have a slight inhibitory influence on movements of some animals, but most of the negative impact of roads is associated with traffic. Trench alignments will be similar to wide dirt roads, without traffic. Food resources for wildlife will be impacted in proportion to the amount of habitat that is disrupted by construction. In all cases, disruption of productive, native wildlife habitat is to be minimized by siting in previously disturbed areas to the extent possible so that facilities construction should have as small an impact as possible.

The most suitable areas for construction from the standpoint of wildlife are those that recover most rapidly from disturbance, are least damaged by earth removal, have low species diversity and richness, and are least preferred by rare, endangered or protected fauna. The annual grasslands are both least damaged by construction and lowest in species diversity and richness.

From the terrestrial fauna perspective, the least suitable area for construction activities may be the Burton Mesa CSA whereas it appears that the three other candidate siting areas will be approximately equally impacted by construction activities. Although the conceptual layouts of shelter and support facilities on Burton Mesa are located on disturbed annual grassland and are likely to have relatively insignificant impact on wildlife, the trenches extend through undisturbed, unique chaparral supporting a number of vertebrate and insect species not found in the adjacent disturbed annual grassland. A canyon containing riparian

Table 3-1. Vegetation/habitat types affected by conceptual layouts of MX trench, shelter, and support facilities in the candidate siting areas. Affected vegetation determined from 1:9,600 vegetation overlays to Vandenberg Base Master Plan C-1 series topographic maps (Oberbauer, 1976) and conceptual facilities layouts.

CANDIDATE SITING AREAS	CHAPARRAL		CHAINED CHAPARRAL		COASTAL SAGE SCRUB STABILIZED DUNE PHASE		COASTAL SAGE SCRUB NORMAL PHASE		ANNUAL GRASSLAND		RUDERAL VEGETATION		MAN-MADE	
	Acres	Hectares	Acres	Hectares	Acres	Hectares	Acres	Hectares	Acres	Hectares	Acres	Hectares	Acres	Hectares
Shuman Canyon Shelters ¹ Support Facilities ²									25.0 30.0	10.1 12.2				
Lompoc Terrace Shelters Support Facilities Trenches ³	22.5 25.0	9.1 10.1	7.5 42.1	3.0 17.0			1.6	0.6	25.0 81.3	10.1 32.9				
Burton Mesa Shelters Support Facilities Trenches	47.5	19.2					2.5 27.2	1.0 11.0	25.0 27.5 68.8	10.1 11.1 27.9	4.0	1.6	2.4	1.0
San Antonio Terrace Shelters Support Facilities Trenches					5.0	2.0	21.6	8.8	25.0 30.0 123.4	10.1 12.2 50.0				

¹Based on nominal 25 acres (10.1 ha) total surface disturbance for three shelters.

²Based on nominal 30 acres (12.2 ha) total surface disturbance for support facilities.

³Based on nominal 100 yd (91.4 m) corridor of disturbance along two 2 mi (3.2 km) alignments.

woodland and a eucalyptus grove important to fauna in the Burton Mesa CSA lies parallel and adjacent to the proposed trench alignments. Moreover, the close proximity of proposed Space Shuttle facilities to Burton Mesa could add to the overall construction impact for MX facilities at this CSA. The stabilized dune areas of San Antonio Terrace and Shuman Canyon may be somewhat sensitive, also, with respect to species such as the California legless lizard (*Aniella pulchra*) but construction should not directly impinge upon them given the conceptual facilities layouts presented in this document. It should be noted, in addition, that some of the areas proposed for construction have been substantially disturbed by past events and consequently, that with selection of either the Shuman Canyon, San Antonio Terrace or Lompoc Terrace CSAs, the faunal impacts are generally expected to be no more than minor in magnitude and minimal in importance. Even with selection of Burton Mesa, impacts of construction upon wildlife will not be high.

Threatened, endangered, or protected species will either not be affected directly by construction activities or could be slightly impacted by loss of habitat or construction noise. These remotely possible impacts are not affected by choice of candidate siting area. For example, the white-tailed kite, a fully protected species under California Fish and Game Code, forages over annual grassland and coastal sage scrub habitats both widespread common [over 39,000 acres (15,789 ha) and 1,900 acres (760 ha), respectively—Reilly, Stutz, and Cooper, 1976] habitats on Vandenberg. Disturbance of less than 200 acres (80 ha) would represent a small loss of habitat. Moreover, this species is commonly observed foraging over annual grassland near highways and builtup areas as on Vandenberg and near Irvine, California, suggesting that it will continue to use areas disturbed by MX activities on Vandenberg. Large, protected raptors such as the California condor, bald eagle, golden eagle, and peregrine falcon, discussed in Section 3.1.1.2.4, do not regularly occur over Vandenberg and in any event, would be unlikely to be impacted by project construction.

The California brown pelican and least tern, both protected as endangered species under federal law, do occur in the near-shore marine environment with the latter species nesting in sand dunes on the immediate coast near the mouth of San Antonio Creek. These species are unlikely to be impacted in any way by project construction confined to the CSA chosen. The possibility of impact to these species during testing activities is reviewed in Section 3.1.1.2.4. No significant impacts from construction are expected on other protected or regulated species on Vandenberg.

In considering isolated specialized habitat types of limited areal occurrence, such as the sand dune systems at Vandenberg, it is useful to consider the concept of habitat islands. This concept was formulated by MacArthur and Wilson (1967) who integrated many concepts of ecology and population biology into a general theory of island biogeography. Their theory has since been extended and applied to management and conservation of species and of habitat.

To a species restricted to a particular habitat type, isolated patches of that habitat type surrounded by habitat unfavorable to the species are biological islands in the same way that oceanic islands are isolated patches of terrestrial habitat, and habitat islands present the same problems to a species as do oceanic islands. In a habitat island, there is a balance between in-migration and extinction for each species that occurs on that island. In-migration rates of a given species depend upon the area of the habitat island (the "size of the target") and the distance from a source population of the species in another patch of appropriate habitat. In-migration rates also depend upon intrinsic characteristics of a species, for example its rate of production of offspring or propagules and its dispersibility. Local extinction depends upon the size of the population, which is partially a function of the area of the island; upon the stability of the habitat; and upon interactions between intrinsic characteristics of the species and the characteristics of the habitat that determine the vulnerability of the species to local extinction.

A large contiguous habitat offers a larger target for in-migrating species, hence, a greater probability that in-migration of a given species will occur. Perhaps more importantly, it permits a larger species population to exist and a greater diversity of situations for that species to occur, thus increasing the probability of survival in the event of unfavorable environmental fluctuations.

Moreover, a larger contiguous habitat island has proportionately less perimeter in contact with surrounding unfavorable habitats. Among other things, this means that on a large contiguous habitat island, propagules or adults of an island species have a smaller chance of accidentally dispersing to and being lost in a surrounding unfavorable habitat than they would on smaller islands. The fact that island plant and animal species tend to lose their powers of dispersal compared to their closest mainland relatives (Carlquist, 1965, 1966) dramatizes the problems of loss of propagules or adults from a small island.

The stabilized sand dunes on Vandenberg serve as an ecological "island" for numerous plant species. A relatively large number of potentially candidate threatened and endangered or rare plant species are restricted or nearly restricted, to this kind of habitat and occur in a limited area of Santa Barbara and San Luis Obispo counties. These dunes also serve as a habitat island for specialized vertebrates and invertebrates confined to sandy habitats, such as the California legless lizard, *Aniella pulchra*, and for numerous host-specific insects, including pollinators and herbivores and their parasites which are restricted to plants occurring only in this area.

The candidate siting areas have been ranked in terms of biological constraints to siting. This ranking, displayed in Table 3-13 is based upon the considerations discussed above. The site-specific discussions following this section will treat impacts in more detail.

Freshwater Biota. In general, the potential for construction-related impacts on freshwater biota is very low since few water bodies are in close proximity to the conceptual facility layouts considered for this report. Furthermore, the potential for impact is limited primarily to the months when rainfall occurs (winter and spring). Sediments due to erosion and runoff from construction areas are most likely to enter the waterways at that time.

The only water body of particular concern is San Antonio Creek since this is the habitat of the endangered unarmored threespine stickleback. This stream is located between San Antonio Terrace and Burton Mesa, but the conceptual facility layouts suggested for these candidate siting areas would minimize the potential for construction-related impacts originating from either siting area. Also, withdrawal of water from San Antonio Creek for construction uses will be avoided, since such withdrawal may adversely impact the habitat of the unarmored threespine stickleback. Biota utilizing the unnamed marsh on San Antonio Terrace are mainly terrestrial or semiaquatic (amphibians and reptiles), and thus, construction-related impacts to aquatic biota will be negligible. On Burton Mesa, construction-related activities will impact the unnamed pond primarily through increased turbidity and sedimentation resulting from runoff since the conceptual trench or shelter layouts are located adjacent to the pond and arroyo draining into it. Although limited data are available concerning the abundance of aquatic organisms inhabiting this pond, low impacts are predicted because disturbances will be of short duration and runoff will be controlled as described in the mitigation section. No impacts to the endangered unarmored threespine stickleback are expected from construction activities of the project.

Marine Biota. The Vandenberg wastewater outfall at the beach near the Santa Ynez River will be abandoned in March 1979. Therefore construction-related impacts on the marine environment should be limited to the areas near the mouths of tributaries (San Antonio and Shuman Canyon creeks and the Santa Ynez River) as they discharge into the ocean. Because of rapid dilution, marine impacts should be very localized and minor. In fact, it is expected that no measurable changes over background conditions will occur in marine invertebrates or vertebrates because of the relatively small volume of freshwater entering the ocean, even during rains. Enhanced nutrients in the mouth of the Santa Ynez River Lagoon will probably not measurably affect marine flora or fauna because of tidal dilutions and flushing. No constructed-related impacts upon marine biota protected by law are expected from the proposed project.

Archaeology (3.1.1.1.8). To the extent that MX construction activities can be confined to areas of low to moderate sensitivity where only limited activity sites are expected, the adverse impact on archaeological resources can be reduced. Even in these areas some adverse impact seems inevitable.

Previous survey and test excavation on Vandenberg has shown that at limited activity sites, cultural remains generally occur primarily upon the present ground surface and that maximum depth of deposits rarely exceeds 0.4 m. Given this situation, any surface or subsurface disturbance within or immediately adjacent to archaeological sites will have an adverse impact on those cultural resources.

The potential for indirect impacts on archaeological resources are most likely to result from the increased activity that will occur within the area before, during, and after construction. The unintentional or unplanned disturbance of additional areas during construction and the intentional vandalism of archaeological resources by construction workers are two common sources of indirect impact. The conceptual layouts on the CSA have been prepared to minimize impacts upon archaeological resources. Specific measures to reduce or eliminate any potential indirect impacts can be developed once a siting area has been selected and a finalized facilities layout plan has been designed.

Operations Impacts (3.1.1.2)

Topography (3.1.1.2.1). Topographic effects due to missile flight testing will be confined to areas of breakout and small areas impacted by test missiles and their recovery. Two ejection tests with recoveries onbase or near offshore area have been planned. All remaining tests will be launched into the Western Test Range and will not be recovered on base. The intention to recover the test missiles implies a need for vehicle access over undeveloped terrain, causing soil and vegetation disturbances. Topographic impacts would be minor if off-road traffic is minimal, but could cause minor wind erosion and gullying of the off-road vehicle tracks. The topographic impacts are expected to be confined to a small area during each of the planned missile ejection tests.

The operational activity that might have a potential effect on topography and geomorphic processes would be the control of windblown sand. This activity is a response to formation of windblown sand deposits on or near missile flight test facilities. Introduction of test facilities may cause change in the natural processes resulting in complex patterns of deflation and dune formation in relation to the facilities.

Breakout testing from buried trenches would cause local disturbances of recontoured ground at the break-out point and further local disturbance by vehicle traffic to that point. Those disturbed sites would be restored and replanted according to the same procedures for restoration after construction of the trench.

Hydrology (3.1.1.2.2). The hydrologic impacts resulting from MX testing at Vandenberg would be essentially the same for each of the four candidate siting areas. Water would be required for the personnel at the site and

for the sanitary waste disposal facilities. A conservative estimate of daily water demand is approximately 150 gallons (0.6 m^3) per day per person. Assuming a work force of approximately 580 persons, water demand would be about 87,000 gallons (330 m^3) per day, or approximately 50 gallons per minute. This amount of water is available from groundwater sources on Vandenberg. Therefore, there would be minimal water use impacts.

Water Quality (3.1.1.2.3). The HCl gas and aluminum oxide released during combustion of rocket fuels may enter adjacent water bodies via fallout, but in such low quantities as to be negligible in altering the pH or constituents in the hard, well-buffered freshwater and marine boundary areas.

Increased personnel required for conducting test firings may contribute to increased wastewater effluent into the Santa Ynez River via the Lompoc Regional Wastewater Reclamation Plant, and thereby increase river nutrient levels. Slightly increased discharges from the Lompoc and Santa Maria treatment plant outfalls are also expected. Septic tank disposal systems are not planned, hence no degradation of groundwater quality is expected.

Misfiring of a missile, although extremely unlikely, could significantly alter surface waterways, depending upon the trajectory of the missile and magnitude of the explosion. Initial test launches and later potential aborted launches falling in nearshore or open oceanic waters may cause temporary and localized alterations in water quality, but because of dilution, these water changes should be extremely ephemeral and nontoxic to most marine biota. Landing of missiles in shallow waters near Kwajalein in the Marshall Islands will have less impact than an aborted mission because only the reentry vehicle(s) will land in the shallow waters and it contains no fuel. Previous landings of spent fuel stages in oceanic waters have caused no noticeable environmental impact.

Biological Impacts (3.1.1.2.4). The major impacts of the flight test program on the terrestrial biological environment are expected to include temporary effects on the terrestrial biota from exhaust gases and noise during launches and local effects upon the biota, especially the vegetation, from overburden material and debris fallout and retrieval associated with proposed launch tests.

Studies on the effects of the acidic gases in missile launch exhaust clouds on terrestrial biota show that these compounds can have noticeable deleterious effects on plants and animals. However, the concentrations necessary to demonstrate these effects are larger than concentrations that biota in the area of test launches are likely to experience. To judge from this and from the condition of the vegetation (usually disturbed to begin with) and fauna around launch sites which have experienced repeated launches, the effects of exhaust gases are only expected to be of local and temporary significance.

Impacts of the Ground Cloud on Vegetation. The launch of a missile typically generates a ground cloud in the immediate vicinity of the launch site. This cloud is formed from the combustion products of the missile propellant that are usually emitted during the first 20 seconds of the missile's trajectory. The effect of this ground cloud on terrestrial biota depends primarily upon the nature and concentration of the cloud's harmful constituents; the duration of exposure of the biological environment to these toxic compounds; and the possible chemical reactions of the cloud constituents with water or other natural elements in the environment.

The behavior of the ground cloud is of concern because of its potential impact on the biota. Ground cloud dynamics has been addressed in Section 3.2.2.4, Air Quality Impacts. The environmental concerns about the impact of the ground cloud on plants involve the possible phytotoxicity of the constituents HCl and Al₂O₃.

The Air Force has sponsored basic research on the phytotoxicity of HCl and Al₂O₃ at the Statewide Air Pollution Research Center, University of California, Riverside. Lerman, et al (1975) attempted to determine the concentration of HCl and Al₂O₃ required to induce injury to eight species of ornamental plants selected because of their wide geographical distribution and broad adaptability to different soils and climates. Expression of injury symptom as a function of HCl concentrations is summarized and presented in Table 3-2. The relative sensitivity of these plants to HCl gas is shown in Table 3-3.

Lerman et al., also studied the phytotoxic responses of nasturtium and marigold plants to Al₂O₃ particles, HCl gas and to their combination. There was no visible injury even on those plants which were exposed to relatively high (75 mg/m³) concentrations of Al₂O₃. There were, however, synergistic effects in combining Al₂O₃ and HCl for there were higher degrees of injury in those plants exposed to a combination of Al₂O₃ and HCl as compared to the degree of plant injury caused by HCl treatments at the same concentrations. But the addition of Al₂O₃ to HCl did not lower the threshold levels of HCl required to initiate damage symptoms. The synergistic effects of Al₂O₃ to the phytotoxicity of HCl gas are shown in Figures 3-1a and 3-1b. These tests by Lerman et al., were conducted with concentrations of HCl much higher than the predicted ground level concentrations for HCl from the Shuttle exhaust and for a much longer duration.

These investigations at University of California, Riverside have recently been expanded to include plants found in the general vicinity of Vandenberg. These include Bishop pine, avocado, citrus, and radish. Species selected for the study include: *Briza maxima* (quaking grass); *Salvia patens* (sage), *Cheiranthus* sp. (tickseed), and *Nemophila menziesii* (baby blue-eyes). Difficulties with the propagation of these native species have delayed these particular studies. In the U.C. Riverside

Table 3-2. Expression of injury symptoms on eight plant species exposed to HCl gas.

PLANT SPECIES	HCl CONCENTRATION		
	21-35 mg/m ³	10-21 mg/m ³	1.5-9 mg/m ³
Aster	Temporary wilting, extensive interveinal bronzing on lower leaf surface, necrosis of young tissue.	Interveinal bronzing on lower surface, trace of necrosis.	Trace of necrotic spots on young leaves.
Calendula	Temporary wilting, lower surface bronzing, discoloration, necrosis. The younger the leaf, the more distal the damage.	Bronzing of lower leaf surface, interveinal necrosis, marginal discoloration.	Traces of lower surface bronzing.
Centaurea	Extensive necrosis, rolling, speckling, temporary wilting, discoloration.	Discoloration along the leaf margins, rolling.	
Cosmos	Extensive necrosis, extensive rolling, flower discoloration, tipburn of sepals.	Tipburn, tip rolling.	Tipburn.
Marigold, Dwarf	Severe necrosis of almost all leaves, rolling.	Discoloration, necrosis of mid-aged leaves, some rolling.	Traces of necrosis or discoloration.
Marigold, Sen. Dirksen	Severe necrosis, extensive rolling, tipburn of sepals on flowers.	Interveinal discoloration of mid-aged leaves, some rolling.	Traces of necrosis or discoloration.
Nasturtium	Interveinal bleached lesions, on younger leaves in addition, marginal bleaching and rolling.	Discoloration, necrotic speckling, rolling.	Traces of discoloration.
Zinnia	Bronzing on basal leaf portions, extensive necrosis and rolling on rest of leaf. Occasional petal necrotic spots.	Speckling, interveinal bronzing.	Trace of lower surface bronzing.

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¹Exposure time was 20 minutes. Plants were evaluated 24 hours after exposure.

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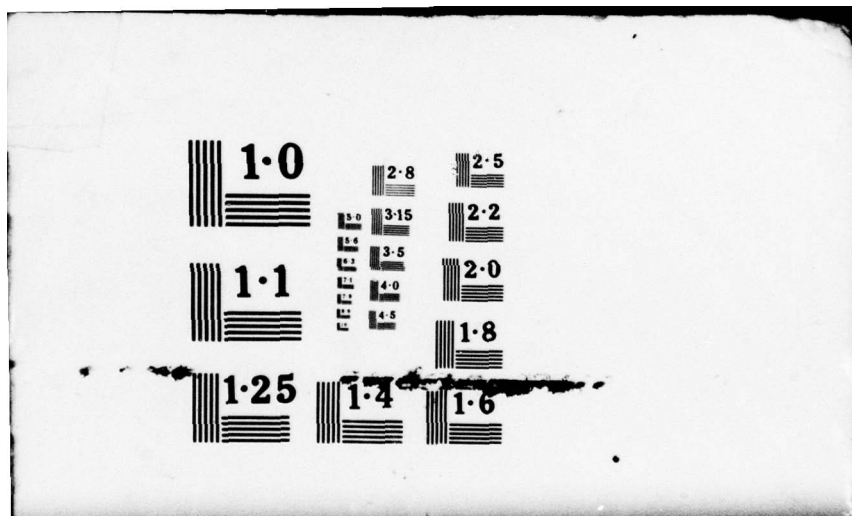


Table 3-3. Relative sensitivity of selected plants to HCl gas.

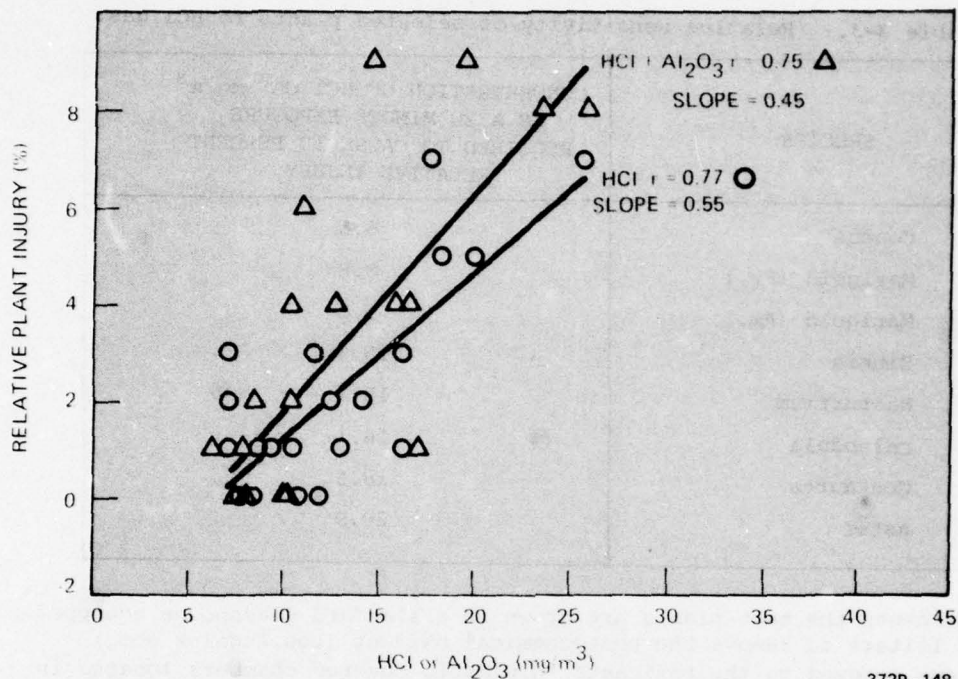
SPECIES	CONCENTRATION OF HCl GAS mg/m ³ IN A 20 MINUTE EXPOSURE REQUIRED TO CAUSE 10 PERCENT RELATIVE INJURY
Cosmos	6.5
Marigold (Fr.)	8.8
Marigold (Am.)	9.5
Zinnia	15.3
Nasturtium	15.7
Calendula	16.1
Centaurea	18.3
Aster	29.9

experiments the test plants are grown in a standard glasshouse equipped with filters to remove the photochemical oxidant (Los Angeles smog) and are exposed to the toxicants in plastic covered chambers located in the glasshouse (Taylor, 1977a). It is therefore difficult to extrapolate from the U.C. Riverside tests to the environmental conditions surrounding the vegetation at Vandenberg. The exposure to HCl from the MX ground cloud would be more ephemeral and less concentrated than that to which the test plants in the confined plastic chambers were subjected.

The research at U.C. Riverside has also begun to focus on the possible effect of HCl on seed production and on seed germination. Marigolds were exposed to HCl gas at four stages of growth, but no difference was noted in seed production between the test plants and the controls (Granett, 1977). Seeds of barley and tomatoes in petri dishes were exposed to HCl gas for 20 minutes or less at concentrations at 25-30 mg/m³ (barley) and 20-40 mg/m³ (tomato). There was significant reduction in both barley and tomato seedling lengths when the seeds were exposed to moderately phytotoxic levels of HCl. Although seedling length may be reduced by HCl, there is preliminary evidence (Granett, unpublished data) that soil may act as a buffer to reduce or eliminate the harmful effects of the gas.

Three general types of vegetation including representatives of native plant communities, ornamental plants, and agriculturally important crop plants are considered at Vandenberg.

[Vandenberg] is of unusual interest since its biota include many species limited in their distribution to the Vandenberg vicinity. Wooten et al., (1974), indicated that the area is



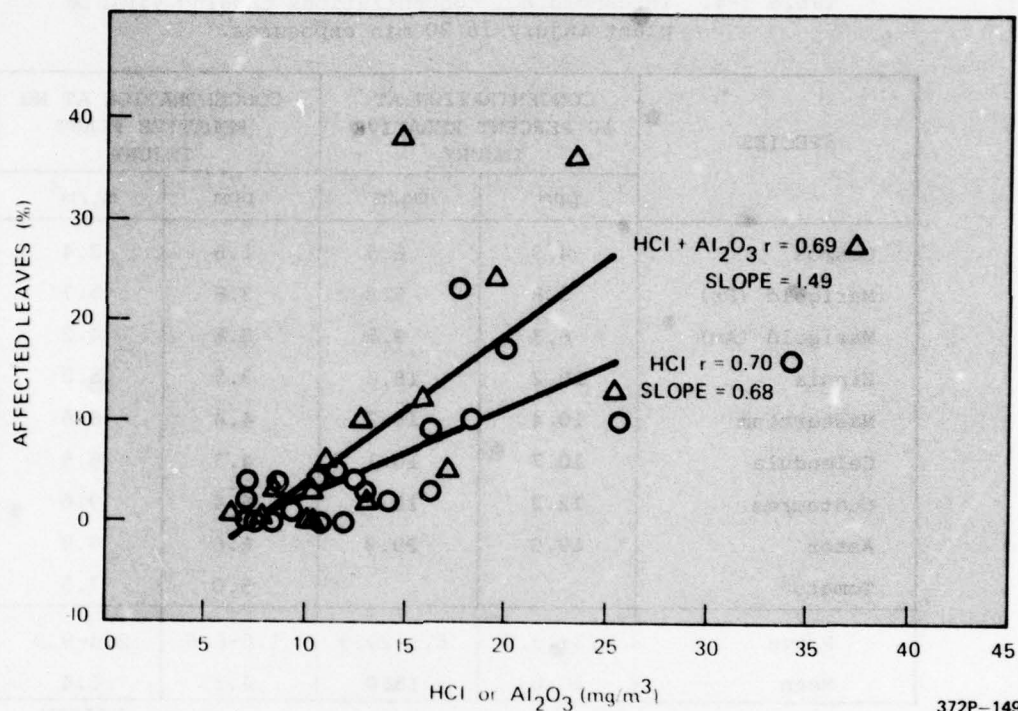
372P-148

Figure 3-la. Relative plant injury induced by HCl gas and HCl-Al₂O₃ particulate combination on American marigolds.

diverse in species composition and contains increasingly rare coastal plant communities. Some of these native plant communities include Bishop pine, forest oak woodlands, tanbark oak, coastal sage, chaparral, grassland, marshes, and stabilized sand dunes (Coulombe and Cooper, 1976).

Another recent analysis of the vegetation at Vandenberg AFB emphasizes the special interest taxa that occur in the vicinity of proposed construction site area for the Space Shuttle program and concludes that construction activities would not jeopardize the continued existence of these species. Certain mitigative measures were recommended (Wooten, R.C. et al., 1977).

The vicinity also contains plants of agronomic and ornamental value. A few miles east of the STS launch site are the research and development fields of the W. Atlee Burpee Floradale Farms in Lompoc, California. This area is used to grow many horticulture crops and for seed production.



372P-149

Figure 3-1b. Incidence of leaf injury induced by HCl gas and HCl-Al₂O₃ gas-particulate combination on American marigolds.

The HCl threshold concentrations causing no visible plant injury in 20 minute exposures and the concentrations causing 10 percent relative plant injury for the same duration are given in Table 3-4. Test plants of corn were 14 day old seedlings grown under greenhouse conditions and exposed for 20 minutes to 1, 5, 10, and 20 ppm HCl (1.5, 7.5, 15, and 30 mg/m³). Temperatures and relative humidity during the exposure period ranged from 20° - 22°C and 34-41 percent, respectively. Symptoms of visible damage to the corn plants were recorded 48 hours post exposure, and typical damage included leaf tip burn, bronzing, discoloration, marginal necrosis, and interveinal necrosis (Table 3-5). The corn varieties exposed to gaseous HCl in Lind's tests appear to be more tolerant of HCl than many of the ornamental plants listed in Table 3-4.

Neither the sensitivities nor even the specific identities of the nonvascular plants such as algae, fungi, lichens, and mosses, or non-moss bryophytes that occur in the vicinity of Vandenberg are known.

Table 3-4. Threshold HCl concentrations causing visible plant injury in 20 min exposures.

SPECIES	CONCENTRATION AT 10 PERCENT RELATIVE INJURY		CONCENTRATION AT NO RELATIVE PLANT INJURY	
	ppm	mg/m ³	ppm	mg/m ³
Cosmos	4.3	6.5	1.6	2.4
Marigold (Fr)	5.8	8.8	3.8	5.7
Marigold (Am)	6.3	9.5	2.8	4.2
Zinnia	10.2	15.3	3.5	5.2
Nasturtium	10.4	15.7	4.4	6.6
Calendula	10.7	16.1	4.3	6.5
Centaurea	12.2	18.3	6.4	9.6
Aster	19.9	29.9	6.6	9.9
Tomato ¹			5.0	7.5
Range	4.3-19.9	6.5-29.9	1.6-6.6	2.4-9.9
Mean	10.0	15.0	4.3	6.4

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¹30 min exposure of 12 varieties of tomato at 50 percent relative humidity and reduced light (Jensen, unpublished data).

Table 3-5. Percentage of corn plants showing visible damage 48 hours post exposure.

HCl EXPOSURE (ppm)	SIOWELL'S EVERGREEN	EARLY SUNGLOW	BARBEQUE	GOLDEN BANTAM	GOLDEN CROSS BANTAM	ALL VARIETIES (AVERAGE)
1.4	7.8	3.9	2.0	3.9	0.0	3.5
5.1	9.8	9.8	5.9	7.8	5.9	7.8
9.4	11.8	9.8	2.0	2.0	2.0	5.6
19.3	23.5	41.2	45.1	27.5	21.6	31.4

372T-3071

There are no useful data on the effect of exhaust plume constituents on the vegetation as it exists and grows in these areas. Laboratory studies have produced valuable data on the phytotoxicity of gaseous HCl to selected test plants grown under the controlled greenhouse conditions, but the direct application of these findings to the field environment at Vandenberg and vicinity cannot be made on the basis of the existing body of information.

It is expected that the constituents of the ground cloud from the MX will be the same compounds and will be produced in approximately the same relative proportions as those that compose the Shuttle ground cloud. The MX propellants that will produce the ground cloud may comprise only one-tenth of the volume produced by the Shuttle. To this extent, the potential impacts of HCl on the vegetation would be expected to be less from the launch of MX in comparison to those estimated or predicted for the Shuttle program, although the proximity to sensitive species could result in a significant and local effect. It should be noted that no recorded incidents of acid rainout have occurred to date from Titan III or Minuteman launches at Vandenberg, and there are no reported or known observations of HCl injury to vegetation in the area.

Most soils have a considerable buffering capacity and it is therefore assumed that most soils, including those in the Vandenberg area, could absorb some low pH rain or mist from one or more ground clouds without exhibiting any change.

The results of tests on the phytotoxicity of the constituents of the ground cloud are difficult to relate directly to the field conditions at Vandenberg. Exposures of the plants in chambers within a glass house are not conditions closely resembling those that would be expected from an ephemeral ground cloud rapidly undergoing dilution. No comparisons have been made on the comparative sensitivity of plants grown under the controlled environment of a greenhouse with that of exposed vegetation hardened by the rigors of the natural, fluctuating weather conditions at Vandenberg. The experiences of past launches of various missiles from Vandenberg do not indicate that any major or lasting impact on vegetation has occurred from the phytotoxic compounds in ground clouds. However, the tests by Lind (1977) showed that certain nonvascular plants may be sensitive indicators of air pollution, but very little is known about the algae, fungi, lichen, mosses, etc., in the vicinity of the base. Also, the vast majority of vascular plant species, including special interest taxa, have not been subjected to laboratory tests on their sensitivity to the potential exhaust cloud products. However, it is expected that construction activities, non-project related wildfire, and other similar perturbations will have much more extensive and important impacts on the vegetation than phytotoxic ground clouds during the life of the MX project.

Impacts of the Ground Cloud on Wildlife. HCl gas, HCl aerosol, and admixtures of HCl with alumina dust have been used in studies to assess toxicological effects of rocket exhaust on animals. Sensitivity indicators used in some of these studies have included respiratory damage, skin damage, sight interference, blood pH change, and death. Results of experiments are summarized as follows:

The studies of Wohlslagel et al., (1976), determined 50 percent lethal (LC_{50}) concentrations for rats and mice exposed to HCl for 60 minutes. These were 3,124 ppm for rats and 1,108 ppm for mice. Toxic signs noted during exposure to HCl included increased grooming, and irritation of eyes, of mucous membranes, and of exposed skin. A rapid shallow breathing pattern and fur discoloration to a yellow-green were noted at the end of 60 minutes.

Studies performed on rodents (*Peromyscus*) and bird eggs derived the following implied points:

- Sensitivities to HCl exposures may differ between species of rodents by a factor of approximately 10.
- Exposures to gaseous HCl in solid propellant exhaust that are predicted to occur at or below 500 ft (150 m) above ground throughout the project region are on the order of 100 to 1,000 times less than those known to cause faunal mortality.
- Exposure to solid propellant exhausts containing gaseous HCl concentrations on the order of 100 ppmv for 15 minutes are required to produce mortality in some rodents.
- Exposures to solid propellant exhaust containing gaseous HCl concentrations on the order of 100 ppmv for 15 minutes are required to produce mortality in some eggs.
- Other pollutants such as Al_2O_3 in the ground cloud may synergistically or additively increase the toxicity of the cloud above what is expected from HCl alone.

Studies on the effects of HCl or Al_2O_3 on animal species native to Vandenberg are not known to exist. Test animals used in the studies described above did not include any representatives of several major taxonomic groups such as reptiles, amphibians, or invertebrates.

However, as in the case of the Vandenberg vegetation that has been subjected to exhaust products from launches of a series of missiles without known incidence of significant to lasting injury, there are no indications of severe adverse impacts to the local terrestrial fauna from exhaust products from the launches of Titan III or Minuteman missiles.

The Impacts of Launch Noise on Wildlife. The impact of launch noise and vibration upon wildlife should be considered especially with reference to the federally protected California least tern and brown pelican.

- Two small colonies of California least terns have been located on Vandenberg through intensified efforts by the Least Tern Recovery Team of the U.S. Fish & Wildlife Service. One colony of 10 nesting pairs is located 1/4 mi (0.4 km) south of San Antonio Creek outlet (see Figure 3-2) with another colony of 5 pairs 1 mi (1.6 km) farther south (Calif. Dept. of Fish and Game, 30 June 1978).
- A larger colony of 20 nesting pairs is known from the mouth of the Santa Maria River (Figure 3-2) about 5 mi (8 km) north of the Vandenberg boundary (Calif. Dept. of Fish and Game, 23 June 1978).
- No least terns have been observed at the mouth of the Santa Ynez River during 1978 although they have apparently nested there in previous years (Calif. Dept. of Fish and Game, 30 June 1978; Coulombe and Cooper, 1976).
- The brown pelican has been observed to nest primarily on the Channel Islands, specially Anacapa Island.
- The impacts of launches are unlikely to influence breeding activities of the brown pelican, but the possibility does exist for the California least tern.

The impacts of launch noises upon birds and, in particular, the least tern, are not known. A major concern is that brooding birds might temporarily abandon their nests as a result of noise and vibrations thus exposing their eggs or young birds to adverse temperature changes and to mammalian or avian predators (although the predators are likely themselves to be startled). It is significant to note however, that California least terns sometimes do nest in highly disturbed areas subject to loud aircraft and other man-producing noises such as at Terminal Island in Los Angeles Harbor and at the San Diego Airport (Atwood et al, 1977). At the mouth of the Santa Maria River and at several other nesting localities their nesting habitat has been disturbed by offroad vehicles. The terns nesting on Vandenberg are exposed to regular overflights by military helicopters, a disturbance known to affect shorebirds, and to several missile launches per year (averaging one to two per month). The observations suggest that the least tern is able to accommodate some type of human disturbance.

The proposed MX testing program would consist of approximately 5 launches per year between 1983 and 1987. In addition, the Space Shuttle program projects an average of 16 launches per year between 1985 and 1991. This compares to a recent average of approximately 35 launches per year for the past few years; the long-term average since missile testing began on Vandenberg in 1958 is 70 missile launches per year.

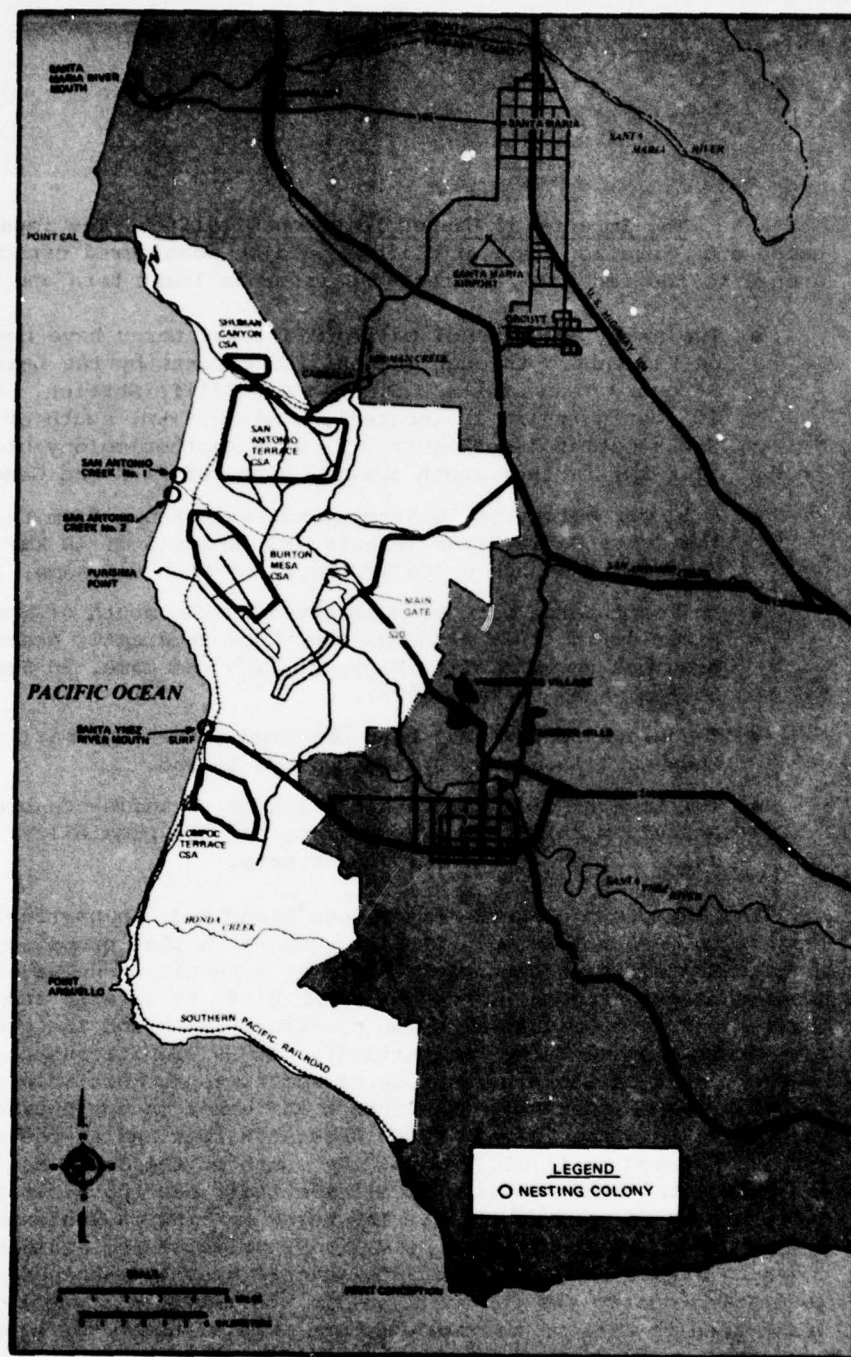


Figure 3-2. Locations of known nesting colonies of least terns in the vicinity of Vandenberg with respect to the candidate siting areas.

In the absence of substantial experimental data or definitive observations, it is not possible to predict impacts of missile launch noise upon the least tern. However, noise levels likely to impinge upon nesting habitats from the different candidate siting areas and different basing mode options can be compared.

Table 3-6 lists the distances between known least tern nesting sites on Vandenberg and the nearest possible launch point for the inline hybrid trench basing mode option and noise levels expected to impinge upon those nesting sites.

Table 3-7 lists the same parameters for discrete aimpoint options. From these data it is clear that the three known nesting sites on Vandenberg are sufficiently close to one or more of the candidate siting areas to be subjected to high sound pressure levels (~ 120 dB) from MX launches. Estimated natural background levels generated by wave and wind action range between 30 and 80 dB in coastal areas similar to those on Vandenberg (Anisimov and Il'ichev, 1975). Of the candidate siting areas, the Burton Mesa CSA is closest to the two active (1978) nest sites near San Antonio Creek and launches from that candidate siting area are likely to generate high sound pressures at known nest sites on Vandenberg (including the Santa Ynez River mouth site which is apparently inactive in 1978). The Santa Ynez River mouth potential nest site would experience high launch noise levels from launches made from the Lompoc Terrace CSA.

Table 3-6. Distance between known California least tern nesting colony sites and the nearest trench mode launch points in the four Vandenberg CSAs and estimated MX launch noise levels impinging on these sites; based on facilities layouts and launch noise estimates presented herein.

CANDIDATE SITING AREA	SAN ANTONIO CREEK #1		SAN ANTONIO CREEK #2		SANTA YNEZ RIVER MOUTH	
	DISTANCE (Miles) (km)	ESTIMATED LAUNCH NOISE dBA/dB	DISTANCE (Miles) (km)	ESTIMATED LAUNCH NOISE dBA/dB	DISTANCE (Miles) (km)	ESTIMATED LAUNCH NOISE dBA/dB
Shuman Canyon ¹	—	—	—	—	—	—
San Antonio Terrace	3.9 (6.2)	95/115	4.5 (7.2)	95/115	8.3 (13.3)	75/100
Burton Mesa	1.2 (1.9)	100/120	1.2 (1.9)	100/120	2.7 (4.3)	85/110
Lompoc Terrace	8.5 (13.6)	75/100	7.8 (12.5)	75/100	1.8 (2.9)	100/120

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¹ Geotechnical limitations preclude construction of inline hybrid trench.

Table 3-7. Distance between known California least tern nesting colony sites and the nearest shelter mode launch points in the four Vandenberg candidate siting areas and estimated MX launch noise levels impinging upon these sites. Based upon conceptual facilities layouts and launch noise estimates presented in this volume.

CANDIDATE SITING AREA	SAN ANTONIO CREEK #1		SAN ANTONIO CREEK #2		SANTA YNEZ RIVER MOUTH	
	DISTANCE (Miles) (km)	ESTIMATED LAUNCH NOISE dBA/dB	DISTANCE (Miles) (km)	ESTIMATED LAUNCH NOISE dBA/dB	DISTANCE (Miles) (km)	ESTIMATED LAUNCH NOISE dBA/dB
Shuman Canyon	4.1 (6.6)	90/115	5.3 (8.5)	90/115	9.2 (14.7)	70/95
San Antonio Terrace	3.5 (5.6)	90/115	4.3 (6.9)	90/115	9.2 (14.7)	75/100
Burton Mesa	2.1 (3.4)	100/120	2.1 (3.4)	100/120	2.8 (4.5)	85/110
Lompoc Terrace	8.8 (14.1)	75/100	8.0 (12.8)	75/100	2.0 (3.2)	100/120

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Previous experience with Minuteman II suggests that the sonic boom from MX will intersect the ground some 15 to 24 mi (24 to 30 km) from the launch site. Thus, there is not likely to be sonic boom impact upon nesting or feeding least terns.

The coastal strand community on Vandenberg is a typical nesting habitat of the least tern. California least terns typically nest on open ground between sand hummocks in the coastal strand vegetation although they have been found on nearly flat, sandy areas such as at Terminal Island, Los Angeles Harbor. Breeding season for the least tern at the Santa Maria River (including nesting and brooding) occurs from early June to early August (Atwood et al., 1977). This period is when the tern would be most subject to adverse impact from noise-related disturbance. Minimization of disturbances during these months would substantially reduce the possibility of impact upon this species.

No impact is expected upon the brown pelican or other nesting birds on the Channel Islands because the trajectory of missiles will be directed westward.

Large migrations of water birds seasonally pass along the coast of Vandenberg, but usually do not venture far inland. An overland route connecting the central valley and the coastal flyway passes approximately over Vandenberg. Water birds potentially migrating over Vandenberg include dabbling ducks, geese, avocets and killdeer. Because of the infrequent launches, no measurable impact is anticipated on the coastal flyway.

Operations Impacts on Aquatic Biology. During the MX testing phase, the project effects which have potential for impacting aquatic biota are the missile ejection tests and missile flight tests. Two ejection tests are planned in which the missiles will land on Vandenberg or in the nearshore areas of the Pacific Ocean. Missile components from the 20 proposed flight tests will land in the Pacific Ocean near Kwajalein Atoll in the Marshall Islands and nearby ocean areas. The potential testing-related impacts on freshwater and marine biota are discussed in the following sections.

Operations Impacts on Freshwater Biota. The two missile ejection tests are expected to have a negligible impact on the freshwater habitats of Vandenberg. Missiles will not be landed in habitats such as San Antonio Creek where the endangered unarmored threespine stickleback lives. Much of this creek on Vandenberg (from west of Barka Slough to its mouth) has been recommended for proposal as critical habitat for this species (Endangered Species Technical Bulletin, April, 1978; Johnson 1978). One of the two tests will utilize a short burn-first stage (Class II propellant), but all of the fuel should be burned before impact, and the missile will be recovered after the test. Consequently, the potential impacts to aquatic biota would be improbable unless there were a direct hit in one of the streambeds.

Flight tests will probably have little impact on most aquatic organisms, except possibly on birds or organisms that are semiterrestrial. The combustion products of concern are HCl and aluminum oxide which enter the atmosphere some distance above ground [approximately 100 ft (31 m) and higher] and are carried by air currents until they settle out. HCl gas is converted into hydrochloric acid when it comes in contact with water (whether high humidity, fog, or rain) and may impact the exposed parts of aquatic macrophytes. Inhalation or surface deposition of HCl and aluminum oxide could also adversely affect aquatic birds and semiterrestrial animals (e.g., frogs, turtles, beaver, etc.) even at some distance from the test site. These impacts, however, would be intermittent and of short duration. Since neither of the combustion products is expected to significantly alter water quality during normal operations, no impacts on completely aquatic, non air-breathing animals and plankton should occur at any of the candidate siting areas.

Noise and vibrations from the test launches may disturb some aquatic fauna and birds for the duration of each launch. Some of the more mobile species may leave the area either permanently or temporarily, but no measurable change in species composition or abundance is expected. No lethal impacts from noise and vibration are expected for any species.

Operations Impacts on Marine Biota. No impacts to the near-shore marine biota are expected, even if two of the missiles are landed in the ocean during the short-burn ejection tests. The fuel should be completely burned before landing, and the release of lubricants or missile parts into the ocean should not adversely impact local marine organisms.

The potential impact of aborted launches are related to landing large pieces of solid fuel and missile hardware in the ocean. The solid fuel is relatively insoluble in water and would most likely sink to the bottom where slow biological or chemical decomposition will occur if the missile is not recovered.

Site-Specific Impacts (3.1.2)

Shuman Canyon Candidate Siting Area (3.1.2.1)

Topography and Geomorphology (3.1.2.1.1). Topographic constraints preclude use of the Shuman Canyon Candidate Siting Area as a realistic location for the buried trench alternative. Use of Shuman Canyon CSA for shelters would require reshaping of the land surface to accommodate the proposed facilities. Only a small portion [0.2 mi² (0.5 km²)] of the land consists of mesa-type area. At the recommended locations, the support facilities would involve cut and fill foundations.

One natural drainage channel at the western edge of the area would have to be filled to provide a sufficiently large flat area for the support facilities. The drainage system there is small, but it would require remedial measures to channel runoff in culverts under the project or to direct flow around it. Erosion, siltation, and gullyng will be minimized if slopes are reseeded and culverts are lined. Figure 3-3 presents the relationship of the Vandenberg CSAs to water bodies and drainage systems on Vandenberg.

A reduction of the aesthetic quality of the area would be a direct effect of the new construction as the natural contours are modified. These impacts will be lessened by careful planning, by designing facilities within constraints imposed by the natural topography, and by balancing cut and fill requirements.

Indirect effects from this action could result in increased erosion, generation of fugitive dust, and increased stream siltation due to an increased amount of fine-grained particles available for wind transport. As the amount of material available for wind erosion on exposed slopes is decreased by revegetation the amount of fugitive dust and fine particles for stream siltation will be reduced.

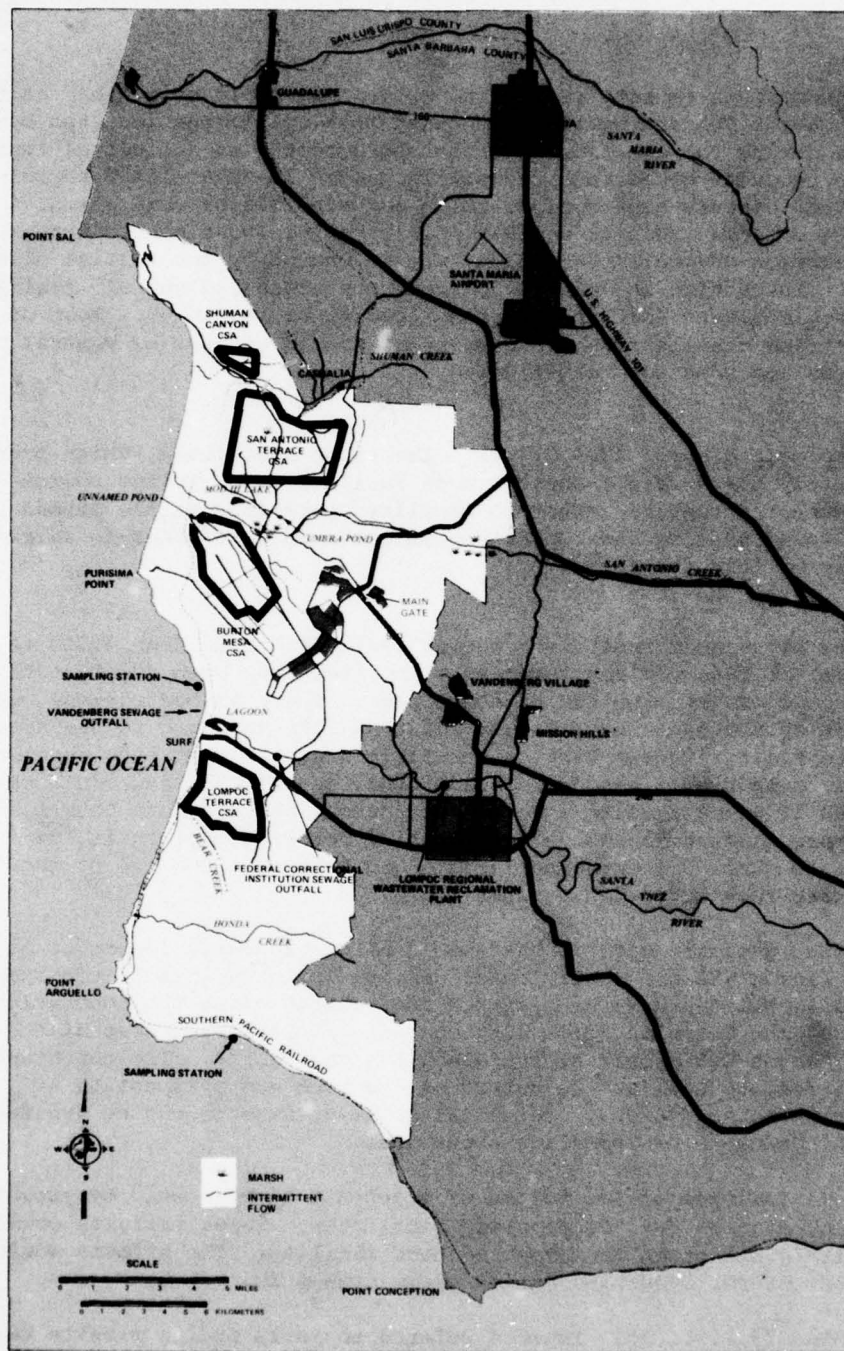


Figure 3-3. The relationship of the four candidate siting areas to surface waters on Vandenberg. Of particular importance from a biological perspective are San Antonio Creek, the habitat for the endangered unarmored threespine stickleback, and the area between Purisima Point and San Antonio Creek where 15 nesting pairs of the endangered least tern were located in Spring, 1978.

Topographic impacts related to MX testing would be minimal at the Shuman Canyon CSA and would be confined to a small area impacted by a missile during the ejection and short-burn tests, or accidental impact. Missile recovery could require vehicle access in undeveloped terrain that would disturb near surface soils and stabilizing vegetation. Indirect effects, such as deflation in areas of loose sand, increased water erosion and gully formation, may be caused by the initial disturbances. Inspection and evaluation recovery areas and vehicle traffic lanes would govern whether the areas need to be replanted. Most of the effects from missile impact and recovery should recover by natural processes and need not be mitigated.

Geologic Hazards (3.1.2.1.2). The Lions Head fault, which crosses immediately north of the shelter mode facility area, is the source for the greatest potential impact to facility operations at the Shuman Canyon CSA. Ground shaking and rupture could occur as a response to seismic activity of this fault.

The Lions Head fault is a normal fault with more than 4,500 ft (1.37 km) of inferred displacement. The fault has been documented to extend 5 mi (8 km) into the offshore area. There is controversy over the location of the fault beyond that point and its juncture to the Hosgri offshore fault. Recent work on the fault suggests that the Lions Head fault is potentially active. In addition, seismic shaking could be expected if an earthquake were to occur along the offshore Hosgri, or other more distant faults. The potential for liquefaction is low because no shallow groundwater exists and because lithology of the subsurface rock mitigates against it.

Other geologic hazards that would be particularly important at the Shuman Canyon CSA are small landslides and failures in soil emplacements. Several landslides have been mapped and located along the southerly margin of the Casmalia Hills although none is known to exist at the Shuman Canyon CSA proper except along the sea bluffs. The topography of the area, as well as the nature of the rock and soil units, is conducive to landslides. Potential negative impacts can be avoided through avoidance of landslide prone areas.

Soil failures of low volume of steepened slopes could be expected during excavation for the proposed facilities. These failures could have little effect on the proposed test facility. The effects would be very short-term, occurring during excavation only.

Soils (3.1.2.1.3). Impacts related to soils during missile testing would be minimal at the Shuman Canyon CSA as the trench mode would not be tested here.

Soil impacts are expected at the Shuman Canyon CSA in the event that construction of the shelter mode launch system is implemented. The total area to be affected based on the recommended facility lay-out is about 15 acres (6 ha). The thin, clayey silt soils would be removed and partly used for fill in grading the site. The shelters would be situated in 15- to 20-ft deep (4.6- to 6-m) expansive, clayey silt soils, overlain by thin silty sand that would be partially removed and used to create the berm over the shelter. The clay content of the soils helps prevent wind erosion; however, disturbed soil areas might experience accelerated water erosion if restoration of vegetation were not instituted. Some bedrock areas would be stripped of soil during grading and building-pad preparation. Those areas of bedrock that would be exposed but not incorporated into the facilities would be covered by topsoil, borrowed from the pad site and stockpiled for that purpose. Construction impacts on soils at the Shuman Canyon CSA would be of minor sensitivity and low magnitude.

Mineral Resources (3.1.2.1.4). Mineral and petroleum resources exist on Vandenberg, but none is currently being exploited at the Shuman Canyon CSA. Generally, the resources found on Vandenberg are not unique to the area, but are widely distributed in the region.

Hydrology (3.1.2.1.5). Construction of the shelter mode test facility in the Shuman Canyon CSA probably would produce a need for several drainage crossings with access roads. At the minor drainage crossings, the roadway would cross the channel on a paved swale. During construction of such a swale, erosion would be increased as the result of disturbance of the natural stream channel. Upon completion of the construction and after a period during which the channel would become reestablished, increased erosion would be minimal.

If any of the final design drainage crossings are judged to be major, the roadway could be carried across the channel on an embankment. Runoff would be routed into culverts through the embankment. The impacts caused by such a crossing would include deposition and erosion scour. The major impact would be the potential threat to the roadway resulting from the effects of flood waters.

Construction of the test facilities would cause a minor change in the infiltration rates. As a result of the soil compaction caused by the operation of heavy construction equipment, the rate of infiltration over much of the site might be reduced. Only minor increases in the impervious area of the site would be caused by construction of the test facility. These changes in infiltration would cause a minor impact within the Shuman Canyon CSA.

The construction activities associated with the test facility might increase depression storage in the area on a short-term basis. The impact of such a change would be to decrease slightly the total runoff from the site and slightly increase the total infiltration. The impact would be minimal.

The primary potential impacts to the local groundwater regime at the Shuman Canyon CSA could result from sanitary waste disposal, construction equipment, wash water disposal, and spills of petroleum products used during construction. Any problems from the above sources would only be of a localized nature. After removal of the thin, expansive, clayey, silty soil, the pervious sand deposits would allow any surface spills to migrate rapidly downward. There are no significant aquifers underlying this site, so little impact on groundwater quality would occur.

Biology (3.1.2.1.6). The major impact on the terrestrial biota is anticipated to be from construction of the shelters, test launch pads, support facilities, and necessary roads. The conceptual facilities layout situates all of these facilities in disturbed annual grassland. Revegetation of cleared areas to the condition of the existing vegetation is expected to be rapid. For the most part, existing roads are employed in this conceptual layout, minimizing the substantial impact of road construction. Impacts of MX construction of the terrestrial biota at the CSA will be confined to the local area and will be relatively temporary. It is not anticipated to affect the overall ecology of Vandenberg in a significant way.

Alternatives to the conceptual facilities layouts involving either Shuman Canyon itself or the dune area to the south of it, if feasible from an engineering standpoint, would involve substantial adverse impacts to the local biology.

Shuman Canyon Creek is located adjacent to the candidate siting area and is the only fresh water body that could be impacted by MX construction and testing activities at this siting area. Figure 3-4 shows the location of the candidate siting area and the general direction of surface runoff from the conceptual facility layout. Runoff enters the lower ephemeral portion of the creek and construction-related runoff is expected to have negligible effects on the aquatic biota. Testing impacts are also expected to be negligible.

Given the conceptual facilities layout, no candidate endangered or threatened plant species are known or expected to occur in the area potentially impacted by construction. However, several species are known or expected to occur in the coastal strand and stabilized sand dune vegetation south of the mouth of Shuman Creek. Construction of shelter mode test facilities located at this candidate siting area are expected to have less significant biological impact than construction of similar facilities at any of the other candidate siting areas.

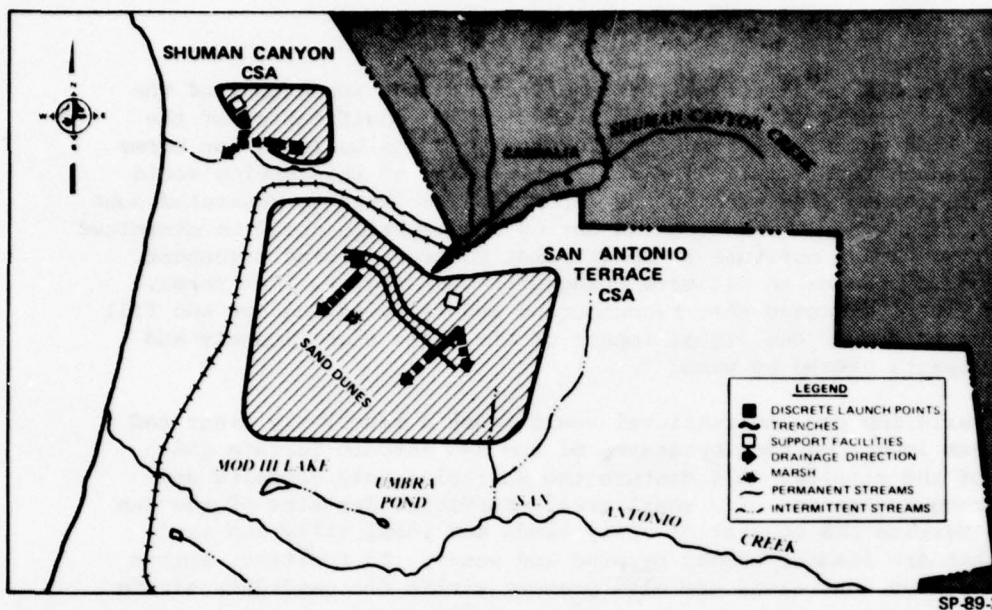


Figure 3-4. Shuman Canyon and San Antonio Terrace candidate siting area showing both shelter and trench conceptual facility layout options. Dashed arrows indicate that runoff should disperse without entering a permanent water body.

Archaeological Resources (3.1.2.1.7). Archaeological data on the Shuman Canyon CSA and its immediate surroundings are sufficient to allow an area of very high sensitivity. The launch facilities access roads, as presently located in the conceptual facilities layout, would impact a large multiple activity site. Because of the site's high archaeological sensitivity and topographic constraints, finding a more suitable site for relocation of these roads or launch facilities within the boundaries of the siting area could prove difficult.

San Antonio Terrace Candidate Siting Area (3.1.2.2)

Topography and Geomorphology (3.1.2.2.1). The proposed layout of the facilities would use the flat terrace surface east of the irregular topographic dune areas, avoiding much of the possible topographic impact. However, should a new road be cut through the older dune area, it will considerably alter the topography. Several road cuts and areas of fill would be needed to create uniform road grades. Maximum cuts and fills are expected to be as much as 50 ft (15.2 m) high. Drainage in the area is already poor and would not be modified by the project.

There would be direct aesthetic effects on the topography of the San Antonio Terrace CSA. This would result from modification of the existing land surface by road construction and from building low berms for the launch facilities. The indirect effects of this action would include increased wind erosion and deposition, as well as generated dust during strong winds. Wind erosion during construction could be minimized by applying enough moisture to spoil piles to prevent wind transport. Little could be done to mitigate changes to the original land forms. However, it is expected that recontouring and revegetating cut and fill slopes could reduce the visual impact of the scars significantly and reduce impacts caused by wind.

Missile impacts and retrieval would cause a relatively minor and short-term impact on the topography of the San Antonio Terrace CSA. Impact of the missiles will disturb the surficial soil deposits and stabilizing vegetation of a small area. Surficial deposits of the San Antonio Terrace CSA consist of silty sands and local silty and sandy clays that are readily eroded by wind and water. In addition, active and stabilized dune sands are also present within the candidate siting area.

Geologic Hazards (3.1.2.2.2). The San Antonio Terrace CSA could be exposed to several impacts resulting from geologic hazards. Seismic shaking from either the Lions Head fault or the offshore Hosgri fault would be of particular importance. Either of these faults could induce landslides or liquefaction of saturated granular soils, causing failure of graded cut and fill slopes dependent on the following variables: severity of the tremors in terms of duration and wave amplitude, height and gradient of the slopes, and physical nature of the rock material involved. Borings in the area indicate that the perched groundwater is present 20 ft (6.1 m) to 40 ft (12.2 m) below ground level. Soil creep is not expected to occur at the San Antonio Terrace CSA, as it consists mostly of dune and terrace sand not subject to creep because of the moderate slope gradients present.

Soils (3.1.2.2.3). The San Antonio Terrace CSA would experience soil impacts in the area proximal to the proposed test facilities. The disturbance to soils would result from grading, including cuts and fills from traffic of earth-moving equipment from accidental spills of fluids and scatter of construction materials, and from the resulting cleanup within the limits of the facility layout. Trench layouts or shelters and support facilities would be located on the Orcutt Formation east of the dune sands on San Antonio Terrace. The Orcutt Formation and soils derived from this parent material are less subject to erosion and are therefore, more suitable for siting than are both the active and stabilized dune sands to the west. The total area of disturbed soils would be similar to that on Burton Mesa, that is, about 160 acres (64 ha) for the trench mode and 30 acres (12 ha) for the shelter mode.

Mineral Resources (3.1.2.2.4). Petroleum has been produced at San Antonio Terrace with nine wells drilled and seven completed in the Jesus Maria field, north of the base golf course between the old El Rancho Road and the new El Rancho Road. The field, which occupies an area of about 70 acres (28 ha), was shut down in 1958 as the consequence of a subordination contract with Union Oil Company. Imposed oil demand and extraction procedures may result in Union Oil's renewed exploration activities after June 30, 1979. Based on the well data derived during delineation of the field, the proven area of tar-oil production conceivably would not expand. However, based on modern petroleum technology and the national fuel crisis, all-out efforts could be made for further discovery and production. The oil field is presently limited to the area south of the recommended flight test facilities. Construction of the shelter or trench options with support facilities would not affect the mineral resources on San Antonio Terrace; but, some interferences between operation of the MX facility and potential oil production facilities could occur. Interference of the two facilities could be avoided by delaying the exploitation of the oil by location on an alternate CSA or by strict scheduling of the two actions.

Hydrology (3.1.2.2.5). The San Antonio Terrace CSA has no defined drainage channels. Thus, service roads and sections of trench would have no major drainage channel crossings.

Roadside drainage ditches to carry storm water runoff would cause changes in the drainage patterns of the site by concentrating the natural overland flow. The highly compacted road surface probably would increase the imperviousness of the test facility site with a slight change in drainage patterns, an increase in runoff, and a decrease in the time of concentration.

Impacts of the changes in infiltration, evapotranspiration, and depression storage at the San Antonio Terrace CSA would be essentially the same as those described previously for the Shuman Canyon CSA.

Biology (3.1.2.2.6). San Antonio Terrace includes a major proportion of the stabilized dune phase of coastal sage scrub on Vandenberg (Figure 1-29). This vegetational type has been designated by Coulombe and Cooper (1976) as one of four areas of prime ecological significance on the Base. Their designation was based upon several factors.

- This vegetation is found only on Vandenberg and a limited stretch of coastline to the north.
- The bulk of the area surrounding Vandenberg is threatened by suburban development and increasing recreational pressure.
- Several potentially threatened, endangered, or special interest plant species are found only, or primarily, in this vegetation type.

Construction of facilities in this unstable sand dune environment will result not only in local removal of vegetation, but also will provide the potential for invasion by weedy species which in similarly disturbed areas on Vandenberg are making important inroads on the native vegetation. The impact of one such weedy species, Hottentot fig (*Carpobrotus edulis*), which has invaded sand dune habitats throughout Vandenberg, generally starting from an introduction along a roadside, has been substantial. This species forms a dense mat over the sand surface thereby stabilizing it, but preventing the germination and establishment of native annual and perennial plant species. Similar impacts have been caused by beachgrass (*Ammophila arenaria*), a European introduction, which was originally planted to stabilize the sand of unvegetated dunes but has spread vigorously and has eliminated native species from the ground that it invaded. An additional potential effect of removal of vegetation from the stabilized dunes is destabilization which can happen in the form of blowouts—spreading areas of loose denuded sand. Examples of existing blowouts are present in the center of the dunes on San Antonio Terrace and above Bear Canyon, south of the Lompoc Terrace CSA.

Potential launch points in this candidate siting area are located about 4 mi (6.4 km) from small nesting colonies of the endangered least tern. The potential for launch-induced impacts upon this species is discussed above (Section 3.1.1.2.4).

San Antonio Terrace Candidate Siting Area is located between Shuman Canyon Creek and San Antonio Creek with Mod III Lake and Umbra Pond located between the candidate siting area and San Antonio Creek. Figure 3-4 shows the location of the candidate siting area and the general surface runoff patterns from the conceptual facility layouts. Runoff will dissipate in the sand dunes before reaching any water bodies, particularly San Antonio Creek which is the habitat of the endangered unarmored threespine stickleback. Consequently, construction impacts are expected to be negligible to aquatic biota, including the unarmored threespine stickleback. Testing impacts are also expected to be negligible.

On San Antonio Terrace, the location of the trenches, shelters, and support facilities is of great importance in determining the magnitude and kinds of biological impacts. If trenches, shelters, and support facilities are deployed approximately as shown in Figure 3-4, biological impacts from construction will be minimized. Conceptual layouts in the San Antonio Terrace CSA are in areas largely vegetated by a highly disturbed annual grassland composed of introduced weedy annual grasses, aggressive or weedy native annual and perennial herbs, and a small collection of aggressive native shrubs. These species are adapted to disturbance, and are very common throughout the Vandenberg area, with many of them occurring throughout Mediterranean-climate areas of California. There are no federally listed endangered or threatened species nor any rare or special interest species likely to be adversely impacted by proposed project

activities such as conceptualized in this EIS. Other possible layouts, especially layouts which encroach upon the stabilized sand dunes, could produce significant impacts on candidate threatened or endangered plant species on Vandenberg. Deployment of a trench mode testing facility, whatever its layout, will have a more substantial impact upon habitat than will deployment of the shelter mode testing facilities.

Archaeology (3.1.2.2.7). Less than 50 percent of the San Antonio Terrace CSA has been previously surveyed. Limited site work performed for this study identified very high site density along the northernmost edge of the CSA. This area of high density is avoided by the present layout of test and support facilities. Available surveys, recent mappings, and field data have been compared with siting layouts to ensure minimum impact upon known archaeological resources. The overall need for additional data at this site precludes the assessment of alternative road or facilities layouts beyond that included in this EIS.

Burton Mesa Candidate Site (3.1.2.3)

Topography and Geomorphology (3.1.2.3.1). Topography of the Burton Mesa CSA is uniform and would require little surface modification for the recommended facility layout. Some low berms would be created and low depressions filled, but most of the modifications would occur sub-grade and the surface would be restored over the buried structures. The drainage of the area is poor and would not be modified adversely. Some culverts might be required to drain low areas where water tends to stand during the rainy season.

The surface at the Burton Mesa CSA consists of shallow silty sands that can be easily eroded if the natural soil structure or stabilizing vegetation is disturbed. Thus, planned or accidental missile impacts related to missile testing and ground disturbance related to ground traffic during missile retrieval would have a minor local impact on the topography of the Burton Mesa CSA. Soil disruption would contribute to increased wind and water erosion, deposition, and stream siltation. These impacts would be of relatively short duration and would affect only a very limited area of interest. It is unlikely that these impacts could be avoided. Breakout tests would also cause local topographic and geomorphic impacts.

Geologic Hazards (3.1.2.3.2). The CSA on Burton Mesa is subject to earthquake risks exclusive, in all probability, to ground rupture. All slopes that are excavated with bedding planes dipping unsupported out of cut are subject to slippage.

Ground motion, estimated up to 28 percent of gravity horizontal acceleration probability could occur due to earthquakes on the Hosgri fault, the Lions Head fault, or other known active faults of consequence

even though more distant (e.g., the San Andreas fault). In the event of earth tremors, soil liquefaction could occur either as a consequence of perched water conditions or of saturation attributable to a period of intense rainfall.

Soils (3.1.2.3.3). Soil impacts would occur at the Burton Mesa CSA where soils are to be disturbed during construction of the trenches, shelters, and support facilities. The total area of disturbed soils would be about 160 acres (64 ha) for the trench mode and 30 acres (12 ha) for the shelter mode. The facilities would include the trenches or shelters, new roads, and support facilities. Activities during construction that would disturb or contaminate the existing soil are represented by grading, traffic or heavy earth-moving equipment, and spillage of oils, fuels, or construction materials.

Mineral Resources (3.1.2.3.4). No mining activities have occurred at the Burton Mesa CSA although gravel pits and some borrow pits for fill exist in Burton Mesa. The petroleum exploration in the past that has occurred on Burton Mesa was relatively uncommercial and all wells have been reported abandoned. Heavy oil (i.e., low API gravity oil) may be present and future exploration in the form of renewed drilling could occur if rights of entry were given, but based on available information gathered from the California Division of Mines and Geology, prospects for gas discoveries are geologically not good. No impacts on mineral rights or petroleum resources would occur at the Burton Mesa CSA during construction, except impacts to surface entry rights for exploration and development.

Hydrology (3.1.2.3.5) No major drainage crossing would be required for the test trench facility in the Burton Mesa CSA (Figure 3-5). Construction of a test trench facility would cause moderate changes to existing drainage patterns. The required drainage ditches and the disturbances of the natural flow paths during construction would result in higher peak flows, in shorter times of concentration, and in increased erosion.

Construction of shelter facilities and associated roadside drainage ditches could cause changes in the drainage patterns of the site, such as modifying existing overland flow patterns. The road surface would probably be nearly impervious after compaction, bringing about an overall increase in impervious area at the site. As a result of the increased impervious area and changes in drainage patterns, increased erosion, increased peak flows, and decreased times of concentration would be expected.

Potential impacts resulting from reduction in infiltration or evapotranspiration at the Burton Mesa CSA would be essentially the same as or less than those described previously for the San Antonio CSA because of the clays and shale outcrops at the Burton Mesa CSA.

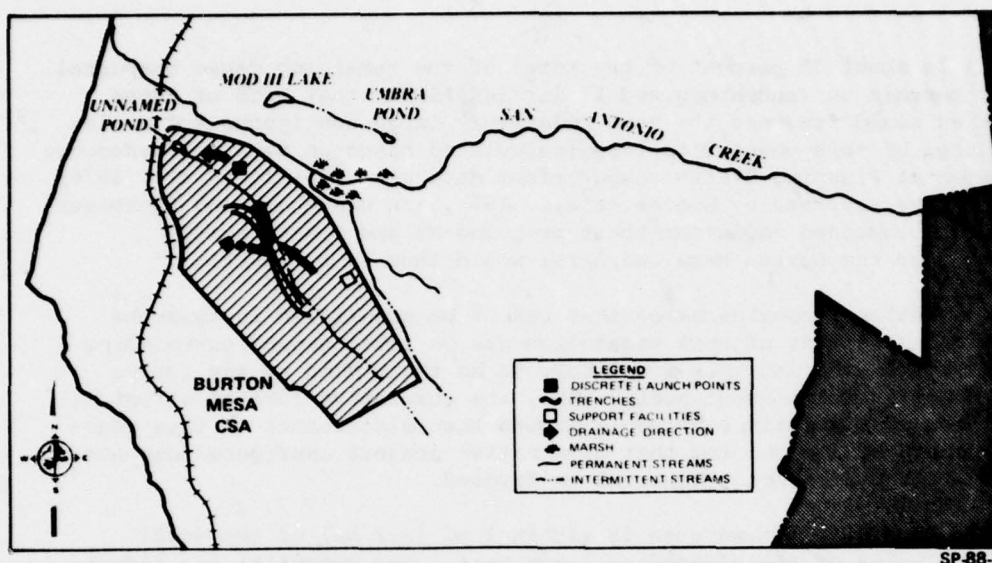


Figure 3-5. Burton Mesa candidate siting area showing both shelter and trench conceptual facility layout options. Dashed arrows indicate that runoff should disperse without entering a permanent water body.

Biology (3.1.2.3.6). As in the CSAs discussed above, the major impact of MX activities in Burton Mesa is from vegetation removal and consequent loss of animal and plant habitat associated with construction. The conceptual layout of shelters and support facilities locates them in previously cleared areas currently vegetated by annual grassland. Construction of these facilities here will have minimal biological impact.

The trench alignments intercept a considerable amount [ca. 6,700 ft (2,000 m)] of relatively undisturbed endemic Burton Mesa chaparral. Assuming a nominal 328 ft (100 m) wide area of disturbance, 47.5 acres (19 ha) of this type would be disturbed representing about 4.2 percent of the total area of dense chaparral on flat terrain on Vandenberg [calculated from Environmental Planning System data base (Reilly, Stutz, and Cooper, 1976)]. Removal of this vegetation along the trench alignment would constitute a considerable biological impact.

This candidate siting area is also adjacent to the runway. Construction of the proposed runway extension and orbiter processing support facilities (see Wooten, Strutz, and Hudson, 1977 and Beauchamp and Oberbauer, 1977) for Space Shuttle would also impact a considerable amount of this vegetation [ca. 295 acres (118 ha) for the runway and 65 acres (26 ha) for support facilities]. The total area of this unique vegetation type removed by both

projects is about 36 percent of the total of the remaining dense chaparral on flat terrain on Vandenberg and it is significant that both of these activities would fragment the same relatively large contiguous and undisturbed area of this vegetation type [calculated based on data in Vandenberg Environmental Planning System computerized data base (Reilly et al., 1976) and from data reported by Wooten et al., 1977, and Beauchamp and Oberbauer, 1977]. The combined impact of these proposed MX and Space Shuttle activities on the Burton Mesa chaparral would thus be substantial.

An additional consideration that cannot be quantified is that the remaining best stands of this vegetation are on level ground surrounding the cantonment area and thus are likely to be threatened by any future expansion of the cantonment area. Thus, the cumulative (delta) effect of these three considerations strongly argues that disturbance to this vegetation should be avoided and that alternative project configurations not involving the Burton Mesa chaparral be favored.

This candidate siting area is within 2 mi (3.2 km) of two small nesting colonies of the endangered least tern. The potential for launch-induced impacts upon this species is discussed above (Section 3.1.1.2.4).

Freshwater bodies on or near Burton Mesa include San Antonio Creek on the north side of the candidate siting area and an unnamed pond in the northwestern portion of the area. San Antonio Creek is of particular concern since it is the habitat of the endangered unarmored three-spine stickleback. Figure 3-5 shows the location of the candidate siting area as well as the general direction of surface runoff from the conceptual facility layouts. Construction of the trench option or shelter option as conceptually presented should have no significant impacts on the biota of San Antonio Creek. Some surface drainage to San Antonio Creek could occur if construction activities disturb areas north or northeast of the conceptual shelter layouts. Some impacts to aquatic biota will occur in the unnamed pond as the result of construction activities, primarily from increased turbidity and sedimentation. Testing impacts are expected to be negligible for all aquatic biota.

Archaeology (3.1.2.3.7). Data for this area and its immediate surroundings are sufficient to allow predictions of impacts with reasonable confidence. These data suggest that most of the area is of low to moderate archaeological sensitivity. Construction of MX testing facilities as they are presently laid out would directly impact only one known site.

Lompoc Terrace Candidate Site (3.1.2.4)

Topography and Geomorphology (3.1.2.4.1). The topography at Lompoc Terrace CSA is generally uniform, consisting of a smooth surface sloping gently towards the northwest. Not much surface modification would be

necessary to accommodate the planned action. Some low berms would be created, but they would not be prominent in the existing topography. Wind erosion, and subsequent downwind deposition of silt and sand, could occur during construction. The area has little surface drainage because of rapid infiltration rates; thus, no drainage modification would be necessary (Figure 3-6). Gullying adjacent to areas of maximum runoff may occur, especially if sheet-flow surfaces are disturbed.

Wind erosion during construction would be mitigated by the application of water to areas of exposed sand or spoils. Impacts on topography after construction would be minimized by recontouring and replanting the area so as to restore it, as closely as possible, to its natural condition. Revegetation would also prevent further erosion during operation of the facility. Recontouring the berm areas and revegetating the exposed soils would mitigate future erosion impacts, as well.

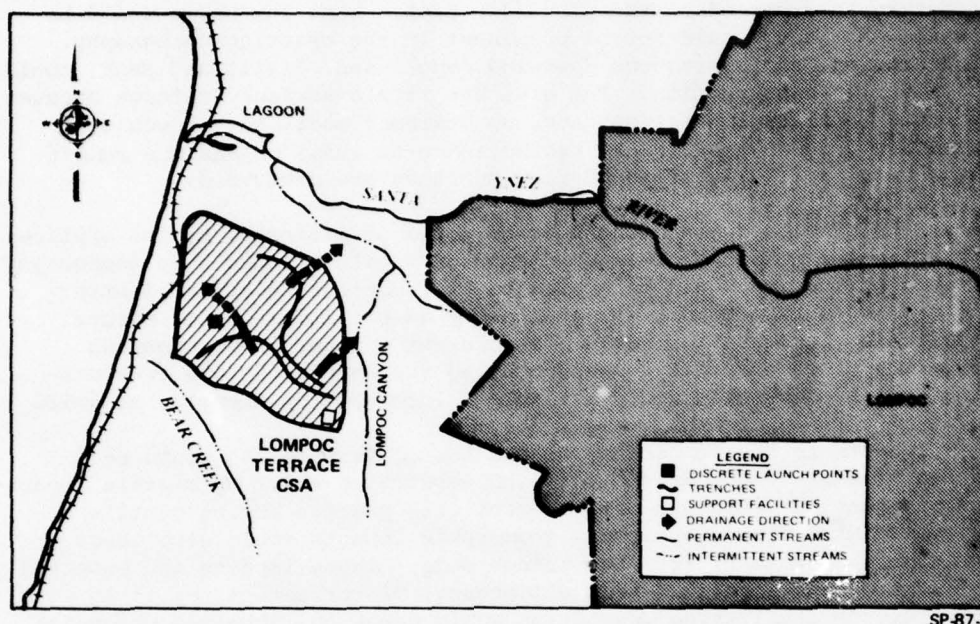
Impacts to the topography of the Lompoc Terrace CSA would be caused by disturbance of the soil and vegetation cover by missile impact during ejection tests and offroad vehicular traffic during missile retrieval. Minor topographic and geomorphic impacts would also occur during breakout tests from the trench mode. These impacts are expected to be minor and localized to small areas. Disturbance of existing soil structure or stabilizing vegetation would cause an increased potential for wind and water erosion.

Geologic Hazards (3.1.2.4.2). The Lompoc Terrace CSA may experience ground shaking due to activity along the Lompoc Terrace, Hosgri, or distant faults.

The Lompoc Terrace fault, located south of the recommended facility layout on the Lompoc Terrace CSA, shows evidence of Quaternary activity. There is a significant difference in amount of dissection of the terrace sand, terrace elevations and stream gradients across the fault, indicating Quaternary uplift of the southern block relative to the northern block (Evenson and Miller, 1963). The topography is markedly different on either side of the fault. This evidence suggests the fault should be considered potentially active and capable of producing seismic shaking and ground rupture.

Other geologic hazards at the Lompoc Terrace CSA include ground rupture and cut slope failures in open excavations if there is surface movement on the southerly unnamed fault. Liquefaction of materials on Lompoc Terrace is unlikely, as the groundwater level is located 100 ft (30.5 m) below the surface.

Soils (3.1.2.4.3). The soils and underlying materials at the site are relatively thick, compressible, silty sands that are erodible when not protected by vegetation and existing soil bonds. The entire project



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Figure 3-6. Lompoc Terrace candidate siting area showing both shelter and trench conceptual facility layout options. Dashed arrows indicate that runoff should disperse without entering a permanent water body.

layout of the shelter or trench mode would be in the Orcutt Formation, away from more erodible stabilized dune sands to the west along the coast. Thus, from the standpoint of reduced erosion potential, the Orcutt sand at the Lompoc Terrace CSA appears to be a favorable location.

The Lompoc Terrace CSA would be exposed to some soil impacts in and adjacent to the proposed project area. It is estimated the area of soils affected would range from approximately 30 acres (12 ha) for the shelters to 165 acres (66 ha) for the trench mode. Grading activities and heavy earth-moving traffic would remove or destroy the natural soil structure and vegetation cover in much of the area. Accidental spills of concrete, oil, and gas may occur that would have minor contamination on local soils.

Soil would be disturbed during some of the launch activities that would include offroad traffic and breakout of missiles from buried trenches. Those areas would be subject to local wind and water erosion effects but are expected to be very minor at Lompoc Terrace.

Mineral Resources (3.1.2.4.4). The Lompoc Terrace CSA has not been used for mineral or construction material extraction. No commercial mineral materials are known to exist there, and future mining activities there are unlikely. Petroleum exploration yielded no discoveries and all exploratory wells were abandoned. Future exploration, if it occurred, would be less likely to find oil here than on the other CSAs because of the pattern of geologic structures. The construction of the proposed test facilities would have no impact on mineral or petroleum resources there. The purported commercially minable deposits of dolomite, found on some 896 acres (358 ha) near the east boundary of Vandenberg and to the southeast of the Lompoc Terrace CSA, are accessible from LaSalle Canyon and should not be affected by the proposed construction at Lompoc Terrace regardless of whether or not they are exploited.

Hydrology (3.1.2.4.5). At the Lompoc Terrace CSA, no defined drainage channels should have to be crossed. This eliminates the need for special drainage crossing structures.

The surficial material at the Lompoc Terrace CSA is moderately permeable, and the water table is 100 to 200 ft (30 to 60 m) below land surface. Vandenberg also has two supplying water wells within the Lompoc Terrace CSA. Any liquid released on the surface could move down into the aquifer. If a spill occurred close to, or upslope from, a Vandenberg well, the liquid released could be intercepted by the well and could contaminate it. Also, large quantity spills in areas not presently pumped may preclude later drilling of water supply wells in those locations.

During construction, there would be some disruption of normal recharge into the aquifer at the construction site. However, the amount of land disturbed will be very small compared to the total recharge. Thus, impacts should be very small.

The construction water supply for the Lompoc Terrace site would probably come from the Lompoc Terrace aquifer. At present Vandenberg is withdrawing 230 acre-ft ($28 \times 10^9 \text{ m}^3$) per year at 143 gallons per minute (0.54 m^3) from the Lompoc Terrace aquifers. If this rate were increased by 20 gallons (0.08 m^3) per minute to 163 gallons (0.6 m^3) per minute, it would still be within the 500 gallons (19 m^3) per minute limit suggested by Evenson and Miller (1963). Any temporary, small decrease in the recharge area to the Lompoc Valley aquifers from the Lompoc Terrace aquifers during construction should not significantly reduce the total recharge rate, hence the additional 20 gallons (0.08 m^3) per minute pumpage should not affect the hydrostatic pressure required to prevent salt water intrusion.

Biology (3.1.2.4.6). Conceptual facilities layouts for this candidate siting area (Figures 1-13 and 1-14) locate shelters and substantial portions of both trenches in annual grassland. Minimum biological impact is anticipated from construction in this habitat type.

The southeastern portions of the trenches and support facilities fall into a vegetation type called "chained chaparral" in Figure 1-45. This is a relatively rich chaparral vegetation that has been treated by a brush control method performed with a heavy chain dragged between two tractors. Alternating east-west trending bands have been treated in this fashion leaving bands of essentially undisturbed mature chaparral.

Although this chaparral vegetation is not as pristine as the chaparral in the Burton Mesa CSA, it is rich in species and contains a number of the special interest plant species listed in the Appendix. It also provides good wildlife habitat. Thus, removal of a calculated 25 acres (10 ha) of undisturbed chaparral and 42 acres (17 ha) of chained chaparral during trench construction would produce a biological impact. The existing level of disturbance on the Lompoc Terrace CSA makes this impact less significant than the potential impact upon chaparral in the Burton Mesa CSA.

The support facilities conceptually illustrated in Figures 1-13, 1-14 are located in a species rich, little disturbed portion of the chaparral. Construction here would cause a significant biological impact, an impact which could be mitigated by locating the facilities in a suitable area within the annual grassland of the candidate siting area.

No freshwater bodies are located within Lompoc Terrace. Figure 3-6 shows the location of the candidate siting area and the general directions of surface runoff. Flows are either to sand dunes areas or intermittent streams which ultimately flow into the Santa Ynez River. Impacts of MX construction and testing activities are expected to be negligible for aquatic biota since water bodies are not in close proximity to the conceptual facility layouts.

Archaeology (3.1.2.4.7). Archaeological surveys have been completed in this area and there are adequate data to predict impacts within the CSA with reasonable confidence. Application of these data to maps of the conceptual facilities layout demonstrates that no known archaeological sites would be impacted by construction of the facilities as they are presently located.

Summary of Impact Potential for Candidate Siting Areas (3.1.3)

This section summarizes in tabular form the environmental characteristics and relative degree of impact associated with the choice of location of the project at each candidate siting area.

Geotechnical and Hydrological Constraints (3.1.3.1). Geotechnical constraints are listed in Table 3-8. A relative listing has been included for each geotechnical feature. From an average geotechnical

Table 3-8. Geotechnical constraint evaluation for MX candidate siting areas.

GEOTECHNICAL PARAMETER	SHUMAN CANYON	SAN ANTONIO TERRACE	BURTON MESA	LOMPOC TERRACE
Terrain Types	SW slopes of Carmalia Hills gradual bench dropping rapidly to shore bluffs and stream canyon	Dunes, sand ridges, wind-blown hollows in SW portion; elevated, gently sloping terrain in NE portion	Relatively flat (incised by a deep ravine)	Undulating to moderately flat (coastal dunes and stream arroyos)
Excavability	Relatively hard to hard; siliceous; Monterey shale and possibility of encountering hard metamorphic material	Mainly dune sand (moderately consolidated at depth)	Firm to moderately firm Orcutt sand and Paso Robles fines (pebbly silt, clay, and sand)	Moderately firm Orcutt sand with basal gravel; some loamy soils
Water Table	Very low (if present) (150 ft [46 m] or more)	Perched water near surface in westerly area (lower in easterly area allowing 150 ft [46 m] excavation in selected areas)	Relatively low (will allow 150 ft [46 m] excavation)	Moderately high to relatively high
Soil Bearing	+6,000 psf	+1,500 psf	+2,000 to 4,000 psf	+1,500 to 4,000 psf
Slope Stability	Steep slopes; adverse structures orientation in cuts prone to landslides	Limited to angle of repose of sand +33° (dry)	No problem unless construction adjacent to arroyo wall	Sloping ground subject to possible soil creep
Drainage Adequacy	Rapid runoff (appreciable water erosion)	Fair to poor (sloughs with no outlets)	Good surface drainage (moisture retaining soils)	Good, both lateral and vertical (pervious soils and underlying aquifers)
Wind Erodibility	15 to 25 percent High in clay, no soil moisture content; excavation in steep terrain will result in high dust yield.	5 to 20 percent Local dust from excavation, but sand textures are relatively low in fines	5 to 10 percent Least dust yield (based on USDA values; dry soil aggregates > 0.84 mm)	10 to 20 percent Clay loam in soils will produce dust when disturbed, however, capillary moisture from underlying aquifer mitigates condition
Seismic Response	<ul style="list-style-type: none"> • Possibility of surface rupture and appreciable lateral movement • Lions Head Fault within CSA 	<ul style="list-style-type: none"> • About 1 mi (1.6 km) from Lions Head Fault • Great thickness of underlying dune sand in SW portion subject to appreciable shaking 	<ul style="list-style-type: none"> • Most favorable • Farthest from potentially active faults 	<ul style="list-style-type: none"> • Possibility of surface rupture and appreciable lateral movement • Lompoc Terrace fault passes just south of the CSA
Mining Disruption	<ul style="list-style-type: none"> • No known minerals reported • Fault pattern and presence of metamorphic ultrabasics rules out oil possibilities 	<ul style="list-style-type: none"> • Union Oil Company subordination of drilling and production rights to June 1979 • Jesus Maria oilfield with capped wells 	<ul style="list-style-type: none"> • Oil subsurface structures known • Future exploratory drilling indicated 	<ul style="list-style-type: none"> • Remote possibility of oil • Mineral subsurface rights to purported dolomite claims cover 896 ac (358 ha) offsite in southeasterly area of VAFB

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perspective Burton Mesa is preferred, followed by Lompoc Terrace, with San Antonio Terrace and Shuman Canyon roughly equivalent for shelters but Shuman Canyon ruled out for trenches. These results are summarized in Table 3-9.

Hydrological sensitivities are summarized in Table 3-10 and the relative acceptance of the sites is found to be in the same sequence: Burton Mesa, Lompoc Terrace, San Antonio Terrace, and Shuman Canyon.

Meteorology and Air Quality (3.1.3.2). Meteorological characteristics associated with transport of construction dust are summarized in Table 3-11. The project will produce short periods of visible dust but no consistently degraded periods with large area reduced visibilities

Table 3-9. Relative geotechnical sensitivity of candidate siting areas.

CANDIDATE SITING AREA	GEOTECHNICAL SENSITIVITY	COMMENTS ON GEOTECHNICAL SENSITIVE FEATURES AND CONSTRAINING FACTORS
Shuman Canyon	Moderate impact potential for shelter (unacceptable for trench)	<p>Topography is irregular and will require modifications to slopes and drainages. The Lions Head fault passes through the north side of the area and could cause ground surface rupture and high ground accelerations. Some thick erodible and expansive soils mantle the candidate siting area. No known mineral or paleontological sites exist.</p> <p>The topography of the area will not accommodate the trench mode test launch facility. The Lions Head and its branch faults should be avoided.</p>
San Antonio Terrace	Moderate to large impact potential	<p>Topography is irregular on west side and even on east side of San Antonio Terrace. Irregular topography is formed by highly erodible dune sand and is very sensitive to disturbance. No faults are mapped at San Antonio Terrace but the Lions Head and Hosgri faults are near enough to cause strong ground motions. Local liquefactions may occur. The soils in the candidate siting area consist of erodible, silty sands, that have low to moderate compressibility. Petroleum resources have been discovered on the south side and may interfere with construction and operation of the facilities. No known paleontological sites exist.</p> <p>Topographic and soil impacts may be lessened by siting in the eastern portion.</p>
Burton Mesa	Small impact potential	<p>Burton Mesa is very flat and will experience minimal topographic impact. No faults are mapped through the candidate siting area, but the Hosgri and Lions Head faults may cause strong ground motions. The soils have low compressibility and exhibit the potential for erosion and local liquefaction. No known mineral or paleontological sites exist.</p> <p>Liquefaction can be eliminated by draining local perched water or by careful selection of the site to avoid areas of perched water.</p>
Lompoc Terrace	Moderate impact potential	<p>Topography at Lompoc Terrace is fairly even and of low relief leading to minimal topographic impacts. The Lompoc Terrace fault and an unnamed fault pass on the south and north sides of the candidate siting area, respectively. The Lompoc Terrace fault could cause high ground accelerations and surface rupturing. The soils consist of silty sands of low compressibility; and they are erodible. No known mineral and paleontological sites exist.</p> <p>The Lompoc Terrace fault and the unnamed fault should be avoided.</p>

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Table 3-10. Relative hydrological sensitivity of candidate siting areas.

SITE	HYDROLOGICAL SENSITIVITY	COMMENTS ON HYDROLOGICALLY SENSITIVE FEATURES AND CONSTRAINING FACTORS
Shuman Canyon CSA	Large impact potential	Area exhibits rugged topography necessitating possibly two or three drainage crossings, causing increased erosion in comparison to other candidate siting areas. Source of water supply would be aquifers in San Antonio Valley; water supply pipeline would have to cross Shuman Canyon Creek. Maximum pumping distance is approximately 3 mi (5 km). No significant aquifers underlie the site area.
San Antonio Terrace CSA	Moderate impact potential	Area exhibits undulating topography and does not contain any major drainageways. Small and irregular drainageways are dispersed throughout the area. Local flooding occurs in topographically low areas during high intensity rainfall due to the lack of established drainage and relatively impermeable bedrock underlying more permeable granular soils of variable thickness. Source of water supply would be aquifers in San Antonio Valley. Maximum pumping distance is approximately 1 mi (1.6 km). No significant aquifers underlie the site area. Perched groundwaters occur locally.
Burton Mesa CSA	Small impact potential	Area is relatively flat and drainage is typically sheet flow in nature. Source of water supply would be aquifers in the San Antonio Valley. Maximum pumping distance is approximately 1 mi (1.6 km). No significant aquifers underlie the site area. Perched groundwater occurs locally.
Lompoc Terrace CSA	Moderate impact potential	Area gradually rises in elevation to the east and does not contain any major drainageways. Drainage is typically sheet flow in nature; water supply would be obtained locally in the Lompoc Terrace aquifers or from aquifers within Lompoc Valley. Maximum pumping distances range from hundreds of feet to approximately 2 mi (150 m to 3.2 km). Significant aquifer directly underlies the site area. Water presently being withdrawn for VAFB water supply.

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Table 3-11. Relative meteorological (visibility) sensitivity of candidate siting areas.

SITE	METEOROLOGICAL SENSITIVITY	COMMENTS ON SENSITIVE FEATURES AND CONSTRAINING FACTORS
Shuman Canyon	Small impact potential	<ul style="list-style-type: none"> • High dust potential due to soil type • Farthest site from other facilities and populations • Smallest CSA • Ridge intervenes between site and Casamalia which lies NE of the CSA
San Antonio Terrace	Moderate impact potential	<ul style="list-style-type: none"> • Dust potential is high • Relatively removed from proximity to Vandenberg housing • Housing is downwind of the CSA • Dust could interfere with other base programs. Mitigation probably required.
Burton Mesa	Large impact potential	<ul style="list-style-type: none"> • Dust potential is low • Close to Vandenberg housing • Housing is downwind of the CSA • No terrain features to divert airborne dust away from populated locations • Heavy dust could interfere with other program activities not related to MX. Mitigation would be required.
Lompoc Terrace	Moderate and large impact potential	<ul style="list-style-type: none"> • Somewhat lowered dust potential due to soil make-up • Closest site to offbase locations • Lompoc is downwind but some distance away • Agricultural land lies between the CSA and Lompoc • Dust could cause a few complaints and probably would require mitigation.

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are projected to occur. The relative acceptability of each site is based primarily on the location and/or concentration of human activity downwind of the prevailing onshore winds. This dust potential is not judged to be as important a deciding factor as issues such as air quality, archaeology, or endangered species. Should all other factors be found to cancel, the relative acceptability of the four sites from a dust generation perspective are: Shuman Canyon, San Antonio Terrace, Lompoc Terrace, and Burton Mesa.

The four sites were evaluated on the basis of the amount of pollutants produced by construction and personnel vehicles. Pollutant level is a function of dust potential, travel distance to the site, the

proximity of the site to populated centers, and access routes to these centers. Table 3-12 lists the sensitive features and constraining factors for each CSA. From this assessment, Shuman Canyon is least sensitive and Burton Mesa is most sensitive to changes in air quality.

Table 3-12. Relative air quality sensitivity of candidate siting areas.

SITE	AIR QUALITY SENSITIVITY	COMMENTS ON AIR QUALITY FEATURES AND CONSTRAINING FACTORS
Shuman Canyon CSA	Small impact potential	<p>The small granule size of the soils make the potential for dust generation of this CSA high.</p> <p>The distance which vehicles must travel along available routes from the base boundary to the site varies from 4 mi (6.4 km) for vehicles using Shuman Canyon Road off the Lompoc-Casmalia Highway to 19 mi (30 km) for vehicles traveling through the main gate.</p> <p>Main access routes can be chosen to avoid populated areas. Although CSA is located in close proximity to Casmalia, a ridge intervenes.</p>
San Antonio Terrace CSA	Moderate impact potential	<p>Soil composition is similar to the soil composition of the Burton Mesa CSA with sandy loam, clay and shale, and a low moisture content. Potential for dust generation from construction activities is high.</p> <p>The distance which vehicles must travel along available routes from the base boundary to the site varies from 7 mi (11 km) for vehicles traveling through the Rancho gate from the Lompoc-Casmalia Highway to 14 mi (22 km) for vehicles traveling from the south through the main gate.</p> <p>Main access routes can be chosen to avoid populated areas. CSA is located about 2 mi (3 km) from Casmalia.</p>
Burton Mesa CSA	Large impact potential	<p>The soil composition of sand loam and shale make the potential for dust generation of this CSA low.</p> <p>The distance which vehicles must travel along available routes from the base boundary to the site varies from 7 mi (11 km) for vehicles traveling through the Rancho gate from the Lompoc-Casmalia Highway to 13 mi (21 km) for vehicles traveling through the main gate.</p> <p>Main access routes can be chosen to avoid populated areas. CSA is located in close proximity to Vandenberg's base housing and central area of main activity.</p>
Lompoc Terrace CSA	Moderate to large impact potential	<p>The soil composition consists mostly of sand and sandy loam. Potential for dust generation from construction activities is moderate.</p> <p>The distance which vehicles must travel along available routes from the base boundary to the site varies from 1 mi (1.6 km) for vehicles traveling through the south gate from Route 246 to 15 mi (24 km) for vehicles traveling from the main gate.</p> <p>Main access routes pass through populated areas. CSA is located in close proximity to the city of Lompoc and its surrounding agricultural lands.</p>

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Biology (3.1.3.3). On Vandenberg, candidate siting areas involve habitat types that range from unique, pristine habitats upon which rare species of plants potentially protected by law are dependent, to common, widespread disturbed habitat types upon which endangered species are not dependent. Thus, the layout of facilities within the siting area, as well as the choice of the siting area, will determine the magnitude of impacts to the biological environment. Impacts on each candidate siting area have been evaluated in terms of biological constraints to siting. This ranking evaluation is summarized in Table 3-13.

Potential impacts on aquatic biota from construction of MX test facilities at Vandenberg are summarized for each candidate siting area in Table 3-14. Since most water bodies are remotely located relative to the candidate siting areas, the predicted impacts are negligible or very low for all areas.

Archaeology (3.1.3.4). The information relevant to assessing the relative archaeological acceptability of each candidate siting area as a location for MX test facilities is summarized in Table 3-15. The relative ranking system shown in the table is based on incomplete information and of necessity contains some subjectivity. For example, Lompoc Terrace CSA, where no known sites are impacted, is deemed less acceptable than is the Burton Mesa CSA where one known limited activity site is impacted. The high site density in the areas immediately adjacent to the CSA led to this assessment.

Once a siting area is selected and final plans and roads are determined, additional survey work will be required. This work will focus on any modifications to the conceptual layouts shown here and will consider other areas of impact such as access roads, borrow areas, and power lines. The potential for indirect impacts will also be more fully assessed at that time.

Summary (3.1.3.5). There is no clear-cut decision regarding the alternative candidate siting areas from an environmental perspective. Mineral resources, particularly oil, could rule out the biologically acceptable portion of San Antonio Terrace CSA. Potential seismic activity at Shuman Canyon from the Lions Head fault and at Lompoc Terrace from the Bear Creek and Lompoc faults could require additional design features at these sites. The relatively good, from biological and archaeological perspectives, Lompoc Terrace CSA would have the greatest traffic and noise impacts in and around Lompoc when combined with Shuttle traffic to South Vandenberg and the relative nearness of the site to the developed community. Potential air quality and meteorological impacts are greatest from the Burton Mesa CSA but are still somewhat high from the Lompoc

Table 3-13. Relative terrestrial biological sensitivity of MX conceptual facilities layouts at four candidate siting areas at Vandenberg AFB.

CANDIDATE SITING AREA	BIOLOGICAL SENSITIVITY		COMMENTS ON BIOLOGICALLY SENSITIVE FEATURES AND CONSTRAINTS ON ALTERNATIVE ARRANGEMENTS
	SHELTER	TRENCH	
Shuman Canyon	Small impact potential		Shelters and support facilities are located in disturbed annual grassland habitat—minimum biological impact. The riparian scrub vegetation in the canyon and the sand dunes at its mouth are more sensitive; however, these areas seem to lack engineering suitability for facilities installation, thus are unlikely to be directly impacted by construction.
San Antonio Terrace	Moderate impact potential	Moderate impact potential Strong constraints on alternative facilities layouts, potential impact upon endangered species	Trenches, shelters, and support facilities are located in a disturbed annual grassland habitat of low biological sensitivity. Low biological impact should result from construction of test facilities in this habitat. Strong biological constraints are posed upon any alternative arrangements that affect the stabilized sand dunes. This habitat type is designated as one of the "areas of prime ecological significance" on Vandenberg and reaches its best development in this candidate siting area. This habitat type is limited in areal extent, is relatively undisturbed, and is essential habitat for several endemic plant species including candidate endangered or threatened species. Launches from either trench or shelter option could adversely impact nesting colonies of the endangered least tern located 4 mi (6.4 km) to the southwest.
Burton Mesa	Large impact potential	Large impact potential Substantial impact on endemic vegetation and potential impact upon endangered species	Shelters and support facilities are located in disturbed annual grassland and their construction and operation should result in low biological impact. Trenches, however, impact about 47.5 ac (19 ha) of the endemic chaparral of Burton Mesa to which a number of rare plant species are restricted. A large canyon supporting riparian vegetation important for wildlife could also be affected by MX construction according to this layout. Substantial cumulative impact on vegetation (esp. chaparral) and wildlife would result from combined MX deployment in this candidate siting area and extension of the adjacent runway and facilities construction associated with the proposed Space Shuttle. Impacts at this CSA would be substantially mitigated by using shorter (e.g., 1 mi [1.6 km] trenches). Launches from either trench or shelter option could adversely impact two nesting colonies of the endangered least tern located less than 2 mi (3.2 km) to the west.
Lompoc Terrace	Small impact potential	Moderate to large impact potential	Shelters are located in annual grassland and would pose minimum biological impact; trenches impact a substantial amount of a chaparral that is rich in plant species and supports relatively abundant wildlife. Construction of shorter (e.g., 1 mi [1.6 km] trenches) would mitigate this effect. Support facilities would impact the richest portion of this chaparral and their construction in an appropriate place in annual grassland would be a substantial mitigation measure.

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Terrace CSA. The biologically acceptable Shuman Canyon is in the area of greatest archaeological sensitivity, and Burton Mesa, which avoids archaeological sites in the conceptual plan, is in an area that permits little flexibility for the trench alternative due to biological resources.

Decisionmakers are thus presented with alternative impacts to key issues for alternative sites and projects. Recognition of environmental trade-offs and adoption of appropriate mitigative measures as well as incorporation of economic and engineering criteria will lead to the optimal site decision.

Table 3-14. Relative aquatic biological sensitivity of candidate siting areas.

CANDIDATE SITING AREA	BIOLOGICAL SENSITIVITY	COMMENTS ON BIOLOGICALLY SENSITIVE FEATURES AND CONSTRAINING FACTORS
Shuman Canyon	Small impact potential	Shuman Canyon Creek, located to the south of this CSA, is not likely to be impacted by runoff during construction.
San Antonio Terrace	Small impact potential	The unnamed marsh southwest of the conceptual trench layout could be disturbed during construction; however, inhabitants are primarily terrestrial or semiaquatic. San Antonio Creek, to the south of this CSA, is inhabited by the endangered unarmored threespine stickleback, however, this species should not be impacted by construction unless the facilities layout is different from that presented in this document.
Burton Mesa	Moderate impact potential	An unnamed pond near the conceptual facilities layout will be impacted by construction activities, primarily in the form of increased turbidity and sedimentation. No impacts on Santa Ynez River are predicted unless the facilities layout is significantly different from that presented in this document.
Lompoc Terrace	Small impact potential	No water bodies are close enough for potential impacts from construction.

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Table 3-15. Relative archaeological sensitivity of candidate siting areas.

CANDIDATE SITING AREA	ARCHAEOLOGICAL SENSITIVITY	COMMENTS ON ARCHAEOLOGICAL SENSITIVE FEATURES AND CONSTRAINTS
Shuman Canyon	Large Impact Potential	Multiple Activity and Limited Activity Sites known to be present in this area are of a very high concentration of archaeological resources. One important multiple activity site would be impacted by the shelter project.
San Antonio Terrace	Small Impact Potential	Two Multiple Activity and nine limited activity sites are known to exist in the CSA. None is to be impacted by the present site layout. Although there is a high potential for impacts, known highly sensitive areas can be avoided.
Burton Mesa	Small Impact Potential	No Multiple Activity Site known to exist although four limited activity sites are present and one would be impacted by the project configuration. Less concentrated resources and the possibility of avoiding highly sensitive areas exist on this site.
Lompoc Terrace	Moderate Impact Potential	No Multiple Activity sites and only three limited activity sites are known to exist within the CSA boundaries. No sites are projected to be directly impacted but there is high site density immediately adjacent to the CSA and the potential for secondary impacts is deemed high.

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3.2 GENERAL IMPACTS ON VANDENBERG AFB

Onbase Construction Phase Impacts (3.2.1)

Construction of MX facilities at Vandenberg will cause adverse and beneficial impacts of both short-term and long-term duration. The effects of the construction effort (earth moving, vehicular traffic, creation of jobs, etc.) occur during a relatively short period of time (~ 2 years). However, the impacts on the environment of such project effects may or may not be confined to the duration of the construction activity. For example: dust from excavation, pollutants and noise from construction vehicles and machinery, and construction jobs will be of short duration; while the alteration of topography, the loss of or damage to biotic communities or excavation of archaeological sites, will have long-term or even permanent impacts. These latter impacts are all site-specific and are discussed in detail in Section 3.1, Impacts at the Candidate Siting Areas.

Onbase Operations Phase Impacts (3.2.2)

Socioeconomic Impacts (3.2.2.1)

- Onbase Population Growth. No additional construction of base housing units are programmed. Therefore, there will be no increase of permanent residents on Vandenberg Air Force Base. There will, however, be a total increase of approximately 580 contractor and military personnel during base duty hours to work at the MX test site.
- Onbase Hospital. The Vandenberg base hospital is an authorized 45-bed operating hospital and serves both active and retired military personnel and dependents living onbase and offbase. With a total availability of 1,350 bed days/month, the average in-patient monthly bed occupancy is 1,073 or 80 percent of capacity. The anticipated 30 new Air Force personnel can be expected to bring an additional 40 dependents. These 70 new persons will not create any noticeable increase in bed occupancy. The hospital has the capacity to expand to 125 beds in present facilities should there ever be such a need.

- Onbase Water Supply Impacts. The water requirements of the personnel and their families located on the base are estimated to be 65 acre-ft ($8 \times 10^4 \text{ m}^3$) or 1.3 percent of the projected water use at the base in 1981. Vandenberg gets all of its water from underground aquifers on the base. Due to overdraft from these aquifers, its future water supply, like that of the rest of the country, is uncertain. Two new wells completed in 1977 draw water from the San Antonio aquifer which is expected to provide the greater portion of the base's requirements through the mid-1980s. After this, a new supplemental water source will be required. In spite of only a marginal increase over the current requirements, the MX operations would further aggravate the water supply situation on the base.
- Onbase Wastewater Impacts. The total volume of wastewater flow produced during the actual MX operations is unknown at this time. The design capacity of the Lompoc Regional Wastewater Reclamation Plant exceeds any foreseeable increase in average daily flow resulting from MX operations. The portion of these flows that will utilize the onbase distribution system will be limited and within the capacity of the distribution system.
- Onbase Solid Waste Impacts. Since no additional onbase housing requirements are anticipated and Vandenberg has an active recycling program, there will be a minimal impact on the existing waste disposal facilities which have a life of more than 15 years.
- Onbase Land-Use Impacts. It is expected that the impact upon onbase land use resulting from MX operations will be minimal. The only type of land use which would experience any impacts would be onbase recreational areas, and only during MX launches. Such safety restraints apply currently, also, and they are not anticipated to change as a result of MX launches. The specific recreational sites which may be affected will be contingent upon which candidate siting area is finally selected.

Soils Impacts (3.2.2.2). Impacts relating to soils during missile testing would be similar to those expected during construction, but the area affected and the degree of the impact would be much lower. Soils would be disturbed if off-road vehicle traffic is required for missile retrieval or other purposes. Breakout tests of the trench mode would cause minor soil disturbance. Generally, the soils affected are readily erodible once the surficial soil structure and stabilizing vegetation is disturbed and the dune sands are the most sensitive to disturbance.

Some soils may be contaminated by accidental pollutant spills. Most accidental spillages should be confined to project facilities, because the volumes are small and the facilities would be the main site of activity. Spills likely to affect an area of soil may occur during transit of oil, gasoline, diesel fuel, and construction materials along roads or at project facilities themselves. Rocket fuels might contaminate any soil they contact. Efforts to remove spilled materials would

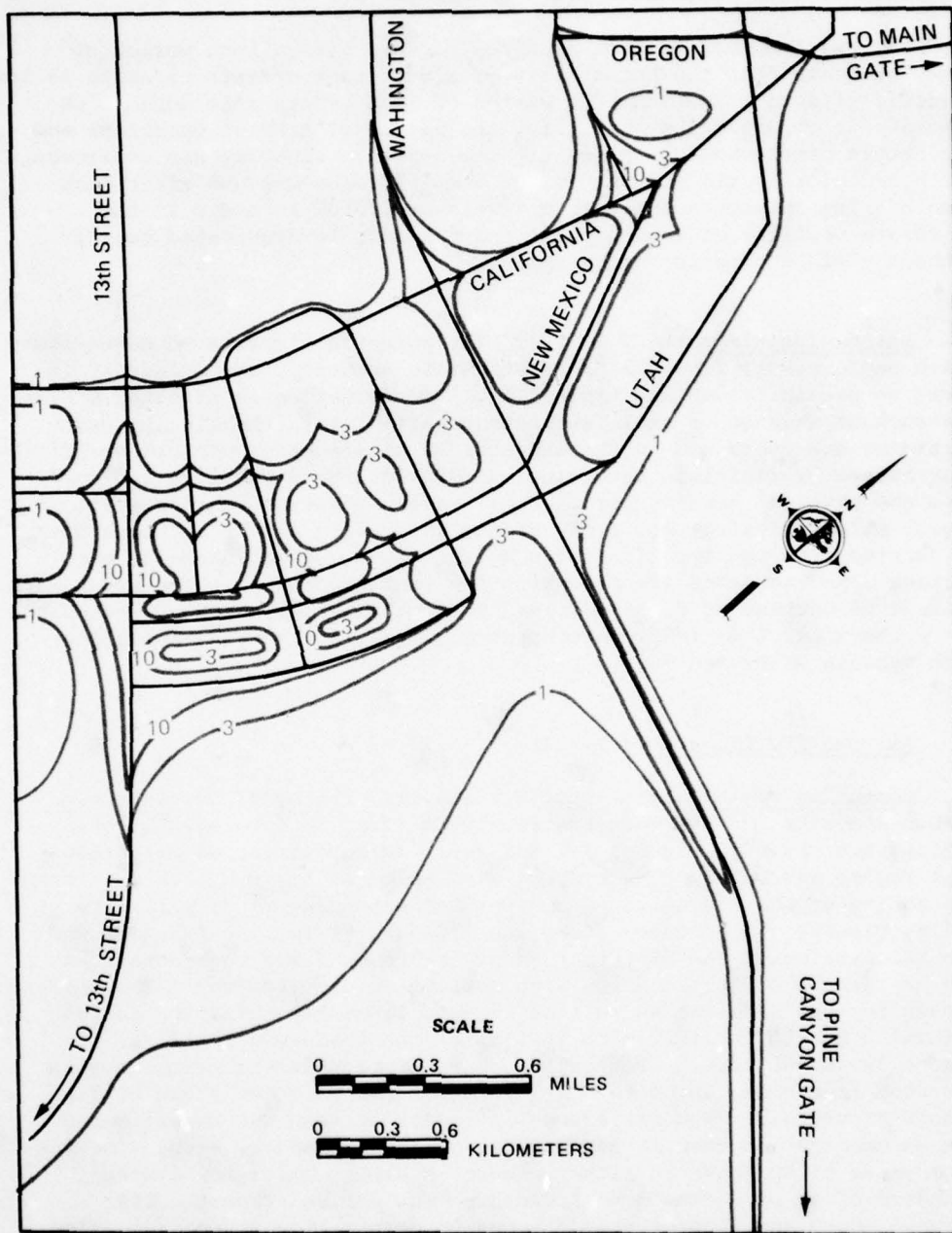
involve removal of the upper few inches of soil; thus, the underlying unstabilized sand would be exposed to erosion agents.

The small number of test launches planned over a long period of time, suggests that the probability of significant effects on soils is low. Specific effects of a launch or series of launches on soil depends on atmospheric conditions at the time, the nature of exhaust emissions and the nature of the soils. Currently some missile launches are monitored for hydrochloric acid content in the atmosphere before and after each launch. The only measurable acid levels are found to occur in the immediate vicinity of launch pads; and the acid is dissipated rapidly without visible effects on the soils.

Meteorology Impacts (3.2.2.3). The potential impacts on meteorology which could result from the MX construction activity, are primarily impacts on precipitation and visibility. Precipitation is affected by the presence or absence of small nucleating particles in the air and such particles are contained in the exhausts of construction vehicle traffic. Dust caused by vehicles traversing unimproved ground surfaces and dust from the physical handling of the soil during construction (excavations, spoils piles, grading, etc.) may affect visibility as the airborne dust is carried from construction sites by the winds. Disturbance of the surface also increases the potential for wind erosion in those areas with a large percentage of finely divided soil material. Increased dust pick-up by the wind, then is a contributor to visibility degradation along with vehicle generated dust.

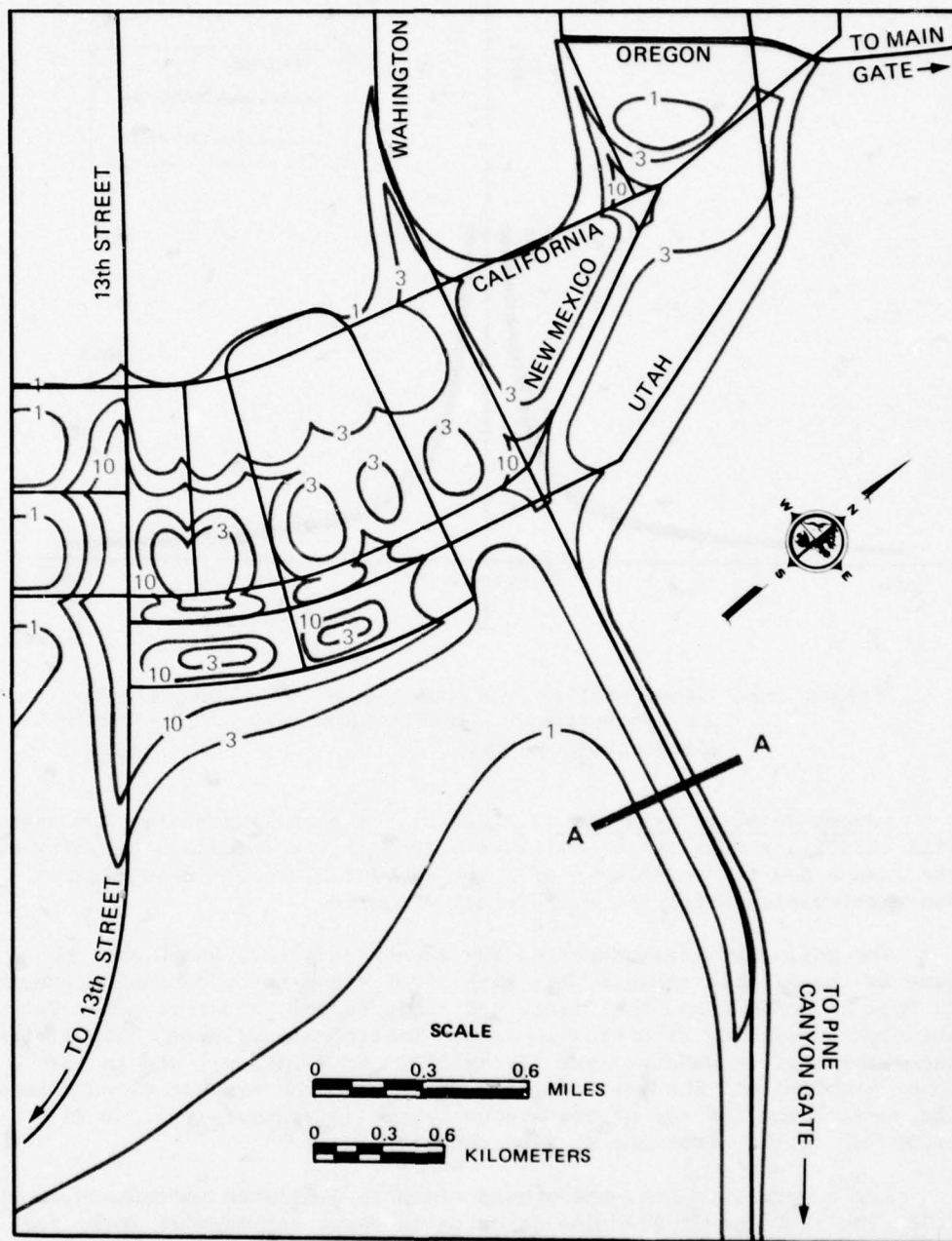
Air Quality Impacts (3.2.2.4)

Commuting Vehicle Emissions (3.2.2.4.1). The modeled results for carbon monoxide for the most restrictive morning meteorological conditions are shown in Figures 3-7 and 3-8. This restrictive meteorological regime was based on an average wind speed of 1.3 mph (0.6 m/s) from the northwest and diffusion parameters corresponding to Pasquill stability class F. Figure 3-7 shows the air quality for the baseline and the MX emissions. The distribution of carbon monoxide concentrations can be seen to be quite narrow with respect to each roadway. The primary impact for the baseline as well as the baseline-MX combination is felt within 50 to 250 ft (15.2 m to 76.2 m) of the roadway centerline. Figure 3-9 shows the theoretical CO concentration distributions across the road from Pine Canyon to Utah Avenue at the location shown by line A-A in Figure 3-8. The difference in impact between the baseline and the MX combination case is very small, as can be readily seen. The maximum value of CO shown in either figure is always below the 1-hour standard of 40 ppm. The model used here was derived from the EPA "Hiway" model and incorporates changes to permit line source summation and wind direction variations to be used (Chan, 1977).



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Figure 3-7. Map showing study area with predicted 1-hour CO concentration isopleths in ppm for base case with most restrictive meteorology.



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Figure 3-8. Map showing study area with predicted 1-hour CO concentration isopleths in ppm for MX case with most restrictive meteorology.

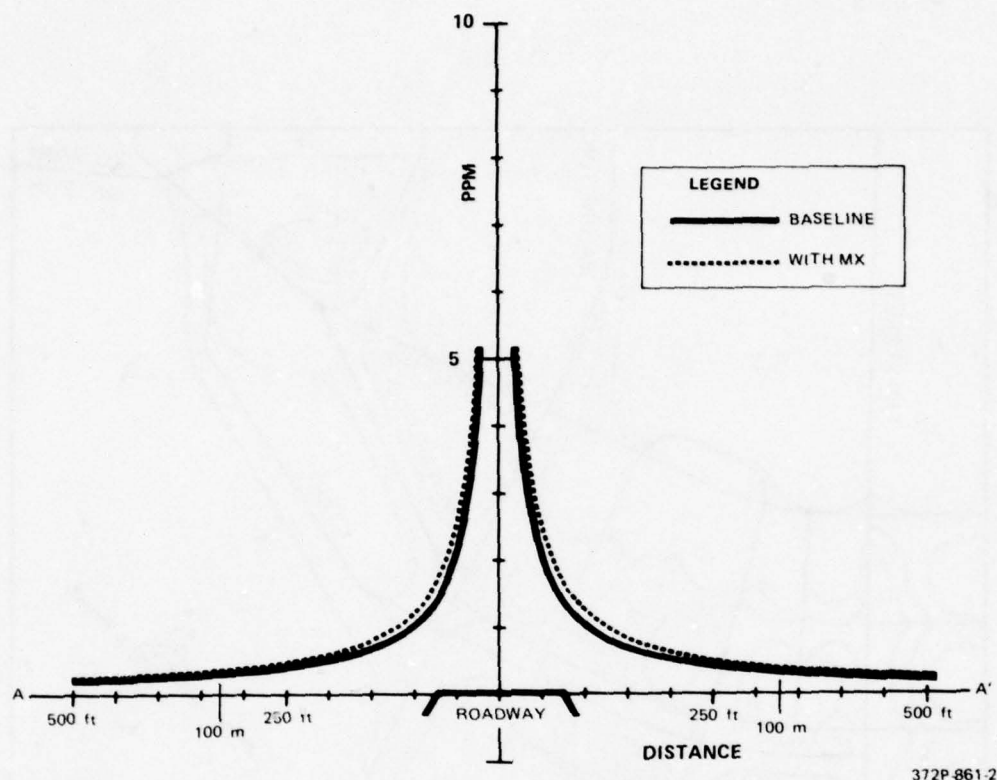


Figure 3-9. Cross-section A-A from Figure 3-8. Theoretical CO concentration distributions across Pine Canyon Gate entrance road.

Launch Emission Dynamics (3.2.2.4.2). The MX launches at Vandenberg will affect air quality to a limited extent in the immediate vicinity of the launch due to the release of a hot buoyant cloud of exhaust gases and particulates after the vehicle motor ignites.

The pollutants released from the launch canister, which are the same as the missile exhaust, mix with first stage motor exhaust products to form a ground cloud that rises and cools rapidly after launch. The emissions resulting from missile launch testing are released both within the atmospheric boundary layer [below 5,000 ft (1,500 m)] and in the upper atmosphere. The greatest concern is with the exhaust cloud between the surface and the top of the mixing layer [approximately 3,300 ft (1,000 m) in the afternoon at Vandenberg].

For a normal launch, the ground cloud is estimated to contain about 1,760 lbs (800 kg) of hydrogen chloride in vapor and droplet form, and about 2,541 lbs of Al_2O_3 (1,155 kg) in the region from the point of ignition to about 1,500 ft (457 m) altitude. This material is formed as the

exhaust constituents cool and may, under the proper humidity levels, form hydrochloric acid and hydrochloric acid gas, both of which are corrosive and toxic (Cramer et al., 1970).

The behavior of the ground cloud is an important factor in its potential impact on air quality. The heat content of the ground cloud causes it to rise to a stabilizing altitude which is determined by the buoyancy of the cloud and the local meteorological conditions. During the first 3 to 5 minutes after launch the elevated ground cloud normally undergoes rapid and progressive expansion as the plume rises, stabilizes and begins to drift with the prevailing wind. It quickly entrains large quantities of atmospheric air, as was demonstrated in an analysis of a cloud from a Titan III launch which showed mass dilution ratios of 1, 2, 3, and 4×10^4 at 2.4, 3.4, 5 and 6.5 minutes, respectively.

The dispersion and distribution of material in the exhaust stream of solid rocket motors has been the object of study by the Air Force and NASA. The rise of heated clouds has been studied, and both laboratory and atmospheric measurements have been made in attempts to identify constituents within the exhaust clouds, and their distribution with time (Bollay et al., 1976; Hwang and Gould, 1977). At Vandenberg, the results of some of these laboratory and dispersion studies were used in a model that has been modified for real-time operational application to estimate the distance from the missile launch point to a specified concentration level downwind, under various meteorological conditions (Table 3-16). Although developed specifically for the Titan III launch vehicle, the model is generally applicable to any rocket launch from Vandenberg. A comparison between the Air Force operational model used at Vandenberg and the one used by NASA in predicting peak HCl values downwind for Titan III launches is presented in Figure 3-10. The proposed MX vehicle is approximately one-half the size of one Titan III solid motor. Therefore, the total MX exhaust emissions to the atmosphere would be less than those released by Titan III by a factor of four.

No launch is permitted at Vandenberg until existing and forecast wind conditions are such that the controlled area associated with the launch falls over an unoccupied area or within a safety control zone. For the proposed MX launch tests, meteorological parameters representative of moderate to poor diffusion were selected for input to the operational model, along with a nominal set of exhaust characteristics, to estimate downwind distances at which the amount of hydrogen chloride in the missile exhaust would be mixed, diluted and diffused to a minimum concentration. This expected short-term concentration is within Short-Term Public Limit Guidelines (Table 3-17). Those areas where HCl levels would exceed 4 ppm, range from less than a mile to approximately 3 mi (4.8 km) from the launch point, depending on source size. However, those excursions above 4 ppm are peak concentrations lasting on the order of minutes.

Table 3-16. Downwind distances to a 4 ppm concentration level for hydrogen chloride from MX launches at Vandenberg (USAF operational Titan III model).

ATMOSPHERIC CONDITION	\bar{U} KTS (m/sec)	σA DEG	ΔU KTS (m/sec)	$\Delta \theta$ DEG	h FEET (m)	Q^1 POUNDS (kg)	X FEET (m)
Steady Light Wind; Low Inversion	4 (2)	7	3 (1.5)	5	500 (152)	770 (350)	9,000 (2,744)
Variable Wind; Mid Level Inversion	7 (3.6)	12	3 (1.5)	5	1,000 (305)	770 (350)	3,800 (1,159)
Variable Wind; High Inversion	7 (3.6)	12	3 (1.5)	5	1,000 (305)	1,540 (700)	8,136 (2,480)
Variable Wind; Low Inversion	7 (3.6)	12	3 (1.5)	5	500 (152)	1,540 (700)	13,950 (4,253)

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\bar{U} = Mean wind speed 12 ft (3.7 m) above the surface

σA = Average wind direction variation 12 ft (3.7 m) above the surface

ΔU = Increase in wind speed from surface to top of mixed layer (inversion base)

$\Delta \theta$ = Mean direction change through the mixed layer

h = Height to base of inversion (mixed layer depth)

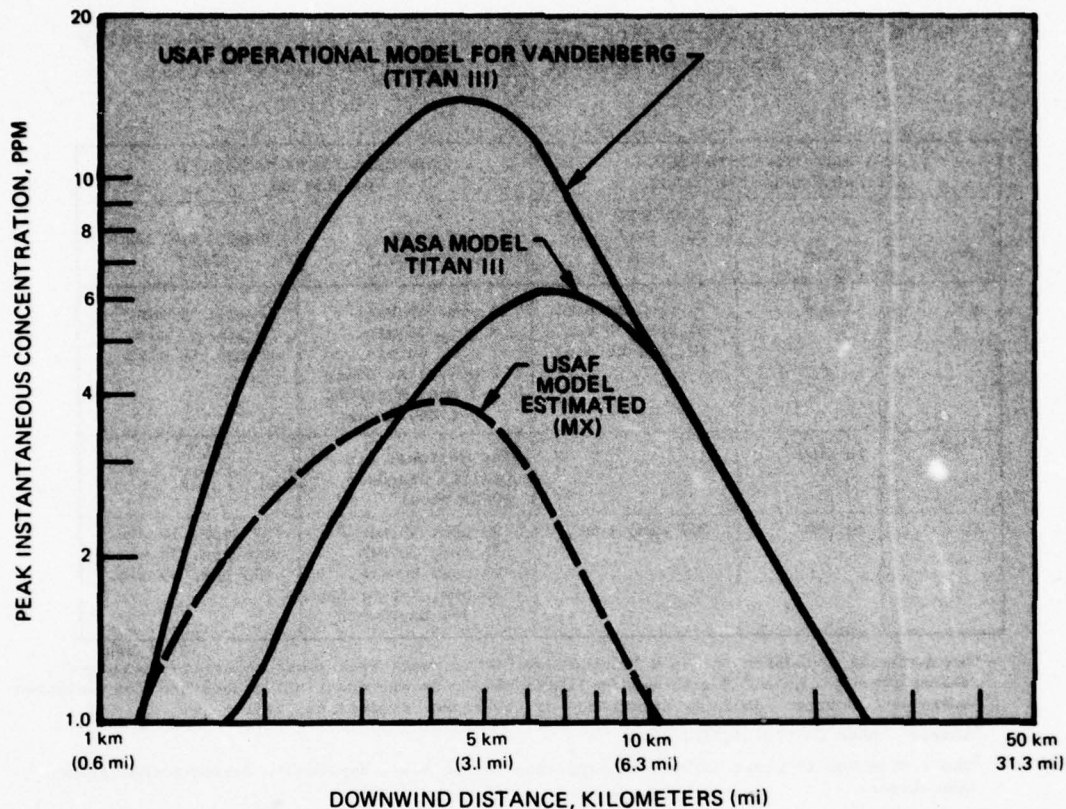
Q = Amount of material released to the atmosphere

X = Distance to 4 ppm concentration level (straight line, downwind)

¹Source strength estimated on basis of two hydrogen chloride release rates, one twice the other.

The behavior of the ground cloud from MX launches at Vandenberg is also expected to be similar to that predicted for proposed Space Shuttle launches in data compiled by the Marshall Space Flight Center (MSFC) for the Vandenberg area (NASA, 1976). However, the amount of gaseous exhaust from a MX launch would be 1/10 that expected from a Space Shuttle launch.

In the MSFC study, one day per week in 1974 was selected randomly and the meteorological data from Vandenberg for each date were then used in the calculations. In all, 48 days were selected. The time at which the data were taken, 0400 PST, corresponds with that time of day at Vandenberg when the atmosphere is generally most stable. Such stable conditions are unfavorable for pollutant dispersion. Using these meteorological data, ground cloud behavior and ground level HCl concentrations were predicted for hypothetical Shuttle launches on each of the 48 days (Table 3-18). Ground cloud stabilization heights varied between 2,296 ft (700 m) and 4,921 ft (1,500 m).



372P-749-2

Figure 3-10. Comparison of predicted peak second level HCl concentration for Titan III launches at Vandenberg (NASA, 1973) and estimated MX levels with USAF model.

These estimates indicate that neither the hydrogen chloride nor the particulate matter (mainly Al_2O_3) introduced into the atmosphere by an MX launch will significantly affect air quality at Vandenberg or in its immediate environs. A short-term impact will occur in the immediate vicinity of the exhaust stream and a short distance downwind. Potentially hazardous levels of hydrogen chloride and considerable amounts of heat, water, vapor, and aluminum oxide will be present as the exhaust ground cloud forms. Rapid atmospheric dilution and chemical stabilization, however, will reduce these to acceptable levels within a few minutes (Cramer, 1970).

Table 3-17. Concentration and exposure criteria for potentially hazardous combustion products and propellants.

CRITERIA FOR CONTROLLED (OCCUPATIONAL) PERSONNEL			CRITERIA FOR UNCONTROLLED POPULATION	
MATERIAL	TLV ¹	SUGGESTED SHORT TERM EMERGENCY LIMIT ²	SHORT TERM PUBLIC LIMIT ³	PUBLIC EMERGENCY LIMIT ⁴
HCl	5 ppm	30 ppm, 10 min. 20 ppm, 30 min. 10 ppm, 60 min.	4 ppm, 10 min. ⁵ 2 ppm, 30 min. 2 ppm, 60 min. 2 ppm, 1 hr daily 0.7 ppm, 5 hr/day 3-4 day/month	7 ppm, 10 min. ⁵ 3 ppm, 30 min. 3 ppm, 60 min.
Al ₂ O ₃	10 mg/m ³		(See National Air Quality Standard 40CFR 50.6)	
CO	50 ppm	200 ppm, 1 hr	90 ppm, 10 min. ⁸ 35 ppm, 30 min. 25 ppm, 60 min. 15 ppm, 4-5 hr/day 3-4 day/month	275 ppm, 10 min. ⁸ 100 ppm, 30 min. 60 ppm, 60 min.

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¹Occupational standards for an 8 hr. workday, 40 hr. work week (for comparative purposes). Values preceded by a "C" are ceiling limits not to be exceeded; all others are time weighted averages. Source: American Conference of Government Hygienists, 1971.

²Source: NASA CR-1205 (III), 1968.

³Short Term Public Limit (STPL), as explained in the text, applicable during normal launch operations.

⁴Public Emergency Limit (PEL), as explained in the text, applicable during unexpected releases (accidents).

⁵Source: National Academy of Sciences; National Research Council Committee on Toxicology, 1971a.

⁶Source: National Academy of Sciences, National Research Council Committee on Toxicology, 1971b.

⁷Source: National Academy of Sciences, National Research Council Committee on Toxicology, 1974.

⁸Source: National Academy of Sciences, National Research Council Committee on Toxicology, 1973.

Launch Emission Impacts (3.2.2.4.3). The major constituents of the ground cloud are aluminum oxide, carbon monoxide, hydrogen chloride, water, nitrogen and carbon dioxide. These exhaust products are distributed along the trajectory with the greatest quantities at ground level

Table 3-18. Shuttle ground cloud data predicted for 48 selected meteorological cases at Vandenberg during 1974.

DATE (1974)	MEAN TRANSPORT DIRECTION (Degrees)	GROUND CLOUD BEHAVIOR PREDICTIONS				GROUND LEVEL HCl PREDICTIONS	
		CLOUD STABILIZATION HEIGHT Feet (meters)	HORIZONTAL DISTANCE TO CLOUD STABILIZATION Feet (meters)	HORIZONTAL DISTANCE TO MAXIMUM GROUND LEVEL CONCENTRATION Feet (meters)	APPROXIMATE HORIZONTAL DISTANCE TO GROUND LEVEL EXPOSURE Miles (km)	MAXIMUM INSTANTANEOUS GROUND LEVEL HCl CONCENTRATION (ppmv)	APPROXIMATE 10-MINUTE TIME-MEAN GROUND LEVEL HCl CONCENTRATION (ppmv)
Wed - 9 Jan	131	3,326 (1,014)	692 (211)	12,300 (3,750)	3.7 (6)	0.22	0.26
Tue - 15 Jan	354	2,703 (824)	1,240 (378)	11,496 (3,505)	3.1 (5)	1.05	0.41
Mon - 21 Jan	172	3,588 (1,094)	1,925 (587)	18,040 (5,500)	4.4 (7)	1.27	0.28
Mon - 28 Jan	170	3,359 (1,024)	4,913 (1,498)	13,940 (4,250)	3.7 (6)	0.15	0.03
Mon - 4 Feb	155	2,572 (784)	43 (13)	15,508 (4,728)	2.5 (4)	1.05	0.93
Sun - 10 Feb	31	3,588 (1,094)	581 (177)	19,680 (6,000)	3.7 (6)	0.39	0.35
Sat - 16 Feb	140	2,801 (854)	807 (246)	9,653 (2,943)	3.1 (5)	0.41	0.27
Sat - 23 Feb	213	2,932 (894)	3,910 (1,192)	16,269 (4,960)	3.1 (5)	0.38	0.05
Sat - 2 Mar	75	3,982 (1,214)	6,744 (2,056)	16,400 (5,000)	4.4 (7)	0.43	0.10
Sat - 9 Mar	185	3,736 (1,139)	1,633 (498)	15,580 (4,750)	3.7 (6)	0.14	0.05
Fri - 15 Mar	190	3,162 (964)	1,194 (364)	18,040 (5,500)	3.1 (5)	0.68	0.37
Tue - 26 Mar	41	3,556 (1,084)	1,679 (512)	17,220 (5,250)	3.7 (6)	0.52	0.22
Mon - 1 Apr	142	3,195 (974)	2,804 (855)	12,300 (3,750)	3.1 (5)	0.24	0.07
Sun - 7 Apr	190	3,260 (994)	6,511 (1,985)	21,320 (6,500)	4.4 (7)	2.69	0.28
Sat - 13 Apr	198	3,411 (1,040)	2,529 (771)	14,048 (4,283)	3.1 (6)	0.18	0.07
Fri - 19 Apr	159	4,280 (1,305)	8,892 (2,711)	21,320 (6,500)	5.6 (9)	0.79	0.18
Fri - 26 Apr	135	3,421 (1,043)	5,271 (1,607)	16,003 (4,879)	4.4 (7)	0.96	0.17
Thu - 2 May	152	3,096 (944)	2,030 (619)	15,941 (4,860)	3.7 (6)	1.01	0.37
Wed - 8 May	155	2,801 (854)	843 (257)	13,632 (4,156)	3.1 (5)	1.39	0.86
Tue - 14 May	159	2,883 (879)	2,834 (864)	17,456 (5,322)	3.7 (6)	2.54	0.53
Wed - 22 May	199	2,850 (869)	1,263 (385)	16,833 (5,132)	3.1 (5)	0.67	0.27
Wed - 29 May	162	3,211 (979)	2,230 (680)	18,129 (5,527)	3.7 (6)	1.65	0.57
Tue - 4 Jun	177	2,686 (819)	705 (215)	12,769 (3,893)	3.1 (5)	0.35	0.10
Tue - 11 Jun	186	2,719 (829)	1,112 (339)	15,895 (4,846)	3.7 (6)	3.08	1.22
Mon - 17 Jun	93	3,949 (1,204)	1,660 (506)	15,196 (4,633)	4.4 (7)	0.19	0.13
Wed - 26 Jun	202	2,391 (729)	1,942 (592)	10,043 (3,062)	2.5 (4)	0.66	0.11
Wed - 3 Jul	283	3,014 (919)	2,070 (631)	16,400 (5,000)	3.1 (5)	0.63	0.19
Wed - 10 Jul	113	3,988 (1,216)	2,276 (694)	18,591 (5,668)	4.4 (7)	0.44	0.38
Wed - 17 Jul	162	2,408 (734)	161 (49)	10,509 (3,204)	2.5 (4)	0.86	0.50
Wed - 24 Jul	256	2,506 (764)	321 (98)	10,125 (3,087)	2.5 (4)	0.46	0.50
Wed - 31 Jul	289	2,736 (834)	285 (87)	9,158 (2,792)	3.1 (5)	0.24	0.24
Tue - 6 Aug	173	2,670 (814)	1,181 (360)	15,741 (4,799)	3.1 (5)	2.04	0.33
Tue - 13 Aug	174	3,457 (1,054)	722 (220)	13,992 (4,266)	3.7 (6)	0.17	0.19
Mon - 19 Aug	165	2,637 (804)	2,909 (887)	13,704 (4,178)	3.1 (5)	2.81	0.51
Sun - 25 Aug	303	3,178 (969)	715 (218)	18,033 (5,498)	3.7 (6)	0.86	0.67
Sat - 31 Aug	101	2,801 (854)	1,056 (322)	15,239 (4,646)	3.1 (5)	0.93	0.50
Sun - 8 Sep	195	2,604 (794)	1,647 (502)	14,245 (4,343)	2.5 (4)	0.46	0.10
Mon - 16 Sep	208	2,834 (864)	1,007 (307)	15,662 (4,775)	3.1 (5)	0.52	0.15
Tue - 24 Sep	157	3,191 (973)	869 (265)	14,757 (4,499)	3.1 (5)	0.36	0.23
Fri - 4 Oct	164	3,523 (1,074)	1,325 (404)	17,748 (5,411)	4.4 (7)	1.04	0.50
Sun - 13 Oct	238	2,539 (774)	672 (205)	15,062 (4,592)	3.1 (5)	2.62	1.97
Mon - 21 Oct	175	2,080 (639)	981 (299)	13,986 (4,264)	3.1 (5)	0.32	0.19
Fri - 1 Nov	140	4,868 (1,484)	4,956 (1,511)	19,693 (6,004)	6.2 (10)	0.46	0.25
Sat - 9 Nov	187	3,310 (1,009)	5,960 (1,820)	23,052 (7,028)	4.4 (7)	2.26	0.27
Sat - 16 Nov	183	2,949 (899)	1,394 (425)	19,021 (5,799)	3.1 (5)	0.31	0.11
Sat - 23 Nov	207	3,080 (939)	4,054 (1,236)	24,669 (7,521)	4.4 (7)	3.38	0.41
Sat - 30 Nov	325	3,162 (964)	3,831 (1,168)	16,282 (4,964)	3.7 (6)	0.99	0.18
Sun - 8 Dec	66	2,703 (824)	2,102 (641)	12,034 (3,669)	3.1 (5)	0.59	0.12

Source: NASA/MASC, 1976.

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where the launch vehicle acceleration is low. Wagner (1975) has calculated these constituents of a typical ground cloud and the expanding plume as shown in Table 3-19.

Emissions of aluminum oxide (Al_2O_3) into the atmosphere occur during the operation of both Titan III vehicles and the Space Shuttle vehicle. Aluminum oxide (Al_2O_3), which is in the form of particulates having a mean size of 10 microns, is classified as a nuisance dust by the American Conference of Governmental Industrial Hygienists. Nuisance dusts are those which have a long history of little or no adverse effect on lungs and do not produce significant organic disease or toxic effect when exposure is kept under reasonable control; however, any dust may have some cellular response in the lungs when inhaled in gross amounts. In the case of nuisance dusts, there is no impairment of lung passages, no significant scar tissues are formed, and any tissue reaction is reversible. Public and industrial exposure standards in effect are listed in Table 3-17. The National Ambient Air Quality Standard 40 CFR 50.6 for particulates in the nuisance dust category specifies as the primary standard an annual geometric mean concentration of $75 \mu\text{g}/\text{m}^3$ and a maximum mean concentration of $260 \mu\text{g}/\text{m}^3$ for 24 hours once a year.

Table 3-19. Constituents of a typical ground cloud.

PRODUCT	PERCENT BY WEIGHT	
	EXIT PLANE	1 km DOWNSTREAM
Al_2O_3	30.2	0.2
CO	24.2	
HCl	20.9	0.1
H_2O	9.4	0.2
N_2	8.7	78.4
CO_2	3.4	0.2
H_2	2.1	
O_2		20.8
Other	0.6	0.1

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Atmospheric diffusion studies conducted for Titan vehicles have shown Al_2O_3 concentrations below standards set by the American Conference of Industrial Hygienists at distances beyond 10 km (6.2 mi). It has been calculated that occupational exposure to the peak predicted Al_2O_3 concentration (28 mg/m^3) would have to occur for 860 minutes to exceed the time weighted 40-hour work week threshold limit value. However, since the peak concentration will decline rapidly beyond 4.7 km ($\sim 3 \text{ mi}$) from liftoff and since the duration of the concentration over any given ground cloud is variable and relatively short, Titan III C and D operations meet the primary standard (SAMSO, Feb. 1975). MX is projected to release less than one-quarter the emissions of a Titan III-D.

The atmospheric diffusion studies conducted by NASA predict maximum exposure levels and concentrations of Al_2O_3 , near sea level and downwind from a normal Space Shuttle launch that are far below levels allowed by California and National Ambient Air Quality Standards. Most of this inert chemical dust will fall out of the cloud within 5 to 10 km (3.10 to 6.21 mi) of the launch site. Some of the Al_2O_3 will remain suspended in the cloud as tiny particles with diameters of 1 micron or less which could penetrate alveolar spaces in the lungs if inhaled. Much of this dust will be coated with absorbed HCl, forming acid particles which may contain aluminum chlorides and oxychlorides. Little is known about the behavior and effects of such chloride particles and no air quality standards or recommended exposure limits exist for them.

Carbon monoxide (CO) is generated at the exit plane of all vehicles utilizing the type of Class II propellant proposed for the MX vehicle first and second stage. CO is not expected to be found in detectable quantities near ground level because it oxidizes to CO_2 due to the initial high temperature of the CO and the abundant presence of oxygen in the boundary layer to complete the reaction.

As indicated in Table 3-17, there are industrial standards for exposure of controlled (occupational) personnel to CO, and there are levels recommended by the National Academy of Sciences/National Research Council for short term public exposures. The National Primary and Secondary Ambient Air Quality Standard (40 CFR 50.8) states that concentrations of CO should not exceed 9 ppm for eight hours more than once in a year period, nor exceed 35 ppm for one hour more than once in a year. The latter standard would limit the absorption of CO into the blood stream to well below a significant level and provide a margin against the hazards of impaired judgment of distances and time intervals.

In the case of the analysis performed for the Titan vehicles (SAMSO, Feb. 1975) the predicted concentrations of CO for the largest of the vehicles are shown to be within the standards indicated by both the American Conference of Governmental Industrial Hygienists and the National Academy of Sciences, National Research Council. Taking into account the short duration of exposure, the predicted concentrations are also below the National Air Quality Standard 40 CFR 50.8.

The small size of the MX vehicle in comparison to Titan and Shuttle vehicles, and the launch frequency of 5 MX vehicles per year, produce an expected effluent per unit volume discharged into the atmosphere that is a factor of six to ten times less than in the case of Titan III or the Space Shuttle respectively. Guidelines developed for general public exposure to HCl by the National Academy of Sciences/National Research Council indicate it has been reported in the United States that the odor threshold for HCl is between 1 and 10 ppm, and that concentrations greater than 5 to 10 ppm are disagreeable or irritating. Concentration and exposure criteria have been established by the Air Force Surgeon General to preclude any irreversible physiological effects or injuries to man. Short-Term Public Limits (STPL) and Public Emergency Limits (PEL) for HCl are presented in Table 3-17.

STPL are used as criteria when assessing predictable excursions arising from single or occasionally repeated events. These would apply during normal launch events. The STPLs for HCl are time-weighted averages not considered to present any health hazard. It should be recognized that excursions above these levels are likely to produce objectionable odors and/or irritations.

Public Emergency Limits (PEL) are Emergency Exposure Limits for the public during situations in which pollutants escape in an uncontrolled manner at unpredicted times and places as a result of accidents, such as, in transportation, fires, launch aborts, etc. Although under optimum conditions, the STPLs require there be no adverse health effects, the PELs recognize the possibility of some temporary discomfort, provided, of course, that the effect is reversible and that no serious sequelae result from it. The impact of the PELs for HCl is felt to be no more than strong odor, or, at the most, slight irritation of the mucous membranes.

In a normal launch, exhaust products are released along the trajectory path and horizontally distributed within the atmosphere by turbulent mixing and transport. The rate of acceleration of the vehicle and staging processes which determine the quantities of exhaust gas emitted per unit length of the trajectory are the greatest at ground level and decrease continuously in the vertical. In a practical sense, the relatively large quantity of exhaust gases in the first 1,500 ft (457 m) of the atmosphere is most likely to be detectable, and in the case of solid rocket motors, has the potential for local short-term measurable polluting of the atmosphere with HCl near ground level. It has been observed from many launches of the Titan and other booster systems that the portion of the exhaust plume that persists for more than a few minutes is that portion emitted during the first few seconds after ignition and which is concentrated in the pad area and referred to as the ground cloud.

In the stabilized ground cloud, the formation and growth of an aqueous acid aerosol population may be influenced by chlorided aluminum oxide particles. There is evidence that a small fraction of the total HCl may react with, and partially chloride the surfaces of the metastable

aluminum oxide particles. Although a critical understanding of many important details of the $\text{Al}_2\text{O}_3\text{HCL}/\text{H}_2\text{O}$ interaction in a ground cloud are lacking, it appears that the solution of aluminum in aqueous hydrogen chloride may increase the rate of acid aerosol growth initially, but then may retard further acid aerosol growth, hastening subsequent evaporation of the initial aerosol at large exhaust cloud dilutions (Wagner, 1975).

Upper Atmosphere Impacts (3.2.2.4.4). Analyses of tropospheric and stratospheric effects for the Space Shuttle solid rocket motor exhaust constituents have been conducted by NASA (Bolley, et al., 1976) and for the Titan III motors by NASA and the Air Force (NASA, 1973; SAMSO, 1975). In all cases effects were found to be small or nonexistent in the troposphere and the stratosphere.

MX launches will emit an estimated 4,400 lbs (2,000 kg) of aluminum oxide into the lowest 2,500 ft (760 m) of the atmosphere, the region where the release of seeding nuclei might be effective. Since this amount is two orders of magnitude smaller than the amount released in the same altitude interval by the Space Shuttle solid rocket engines, it seems appropriate to conclude that the possibility of the MX exhaust effectively causing measureable cloud seeding and therefore precipitation, is very small at Vandenberg. Aluminum oxide quantities released at altitudes from 6,500 ft (2 km) up to 40,000 ft (12 km) are much less concentrated, due to vehicle acceleration than they are below 6,500 ft (2 km) and the possibilities for introducing enough seeding nuclei per unit volume into the atmosphere to cause inadvertent weather modification are even more remote than nearer the ground.

In addition, the normal turbulent mixing and wind shears found at these upper troposphere altitudes rapidly dilute and dissipate the vehicle exhaust constituents. Hydrogen chloride and carbon dioxide are diluted and dissipated at least as well as the aluminum oxide in the upper troposphere and so pose no contamination problems.

Above the tropopause [around 40,000 ft (12 km)], there is in general much less turbulence and mixing. Rocket exhaust constituents therefore, tend not to dissipate as rapidly in the stratosphere as they do below the tropopause. Instead of minutes or hours, dissipation times may stretch out to days or weeks for specific elements. The effect of this slow decrease in exhaust concentration is to potentially build up an undesirable level of pollutant, if releases are sufficiently large or launches occur with high enough frequency. Examination of this problem for carbon dioxide, and hydrogen chloride for the larger Titan III launch vehicle led to the conclusion that no significant effects would be generated as the level of annual emissions from the maximum number of launches, nine per year, was many orders of magnitude below what would be required to produce any detectable changes in the upper atmosphere (SAMSO, Feb. 1975). Since MX test launches are presently scheduled at a rate of about 5 per year and the missile is about one-fourth the size of Titan III, it is

expected that sufficient pollutant to affect the upper atmosphere in any measureable way, including effects on the stratospheric ozone layer between 67,000 and 82,000 ft (20-25 km) will not be generated.

The analysis carried out for the Space Shuttle engines (NASA, 1977) showed that chlorine compounds from 60 launches a year would be responsible for an 0.2 percent decrease in mean ozone concentrations in the Northern Hemisphere. Nitrogen oxides and aluminum oxide particles would be responsible for an additional 0.01 percent reduction. The total effluent quantities released to cause this minor effect are shown in Table 3-20. For 5 launches per year, the MX vehicle would deposit about 29 tons (26 tonnes) of hydrogen chloride, 213 lbs (97 kg) of carbon monoxide, 35 tons (32 tonnes) of carbon dioxide and 8.6 tons (7.9 tonnes) of aluminum oxide into the stratosphere. These amounts of pollutants are less than 1 percent of the Space Shuttle emissions. Consequently, they would be expected to have no measurable effect on the amount of ozone in the stratosphere. Local perturbations can occur in the immediate vicinity of the exhaust trail but they are small and highly transitory in nature.

The MX does not emit enough emissions to produce inadvertent weather modification (precipitation enhancement or suppression) or undesirable changes in tropospheric characteristics (ozone depletion). The relatively small amount of propellant, its limited distribution in the atmosphere as the launch occurs and the small number of launches per year, all contribute to a near zero level of impact in terms of inadvertent weather modification. Locating the launch point in one or another of the candidate siting areas has no effect on this impact parameter so all sites are rated as near zero: small relative impact.

Table 3-20. Total annual stratospheric deposition rates for the specified pollutants for 60 Space Shuttle launches.

COMPOUND	ANNUAL DEPOSIT ABOVE THE TROPOPAUSE	
	TONS	METRIC TONS
Hydrogen Chloride	3,936	3,578
Chlorine	448	407
Nitric Oxide	279	254
Carbon Monoxide	14	13
Carbon Dioxide	8,564	7,785
Water	16,954	15,413
Aluminum Oxide	6,262	5,693

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3.3 IMPACTS ON THE VANDENBERG ENVIRONS

Vandenberg Air Force Base and the neighboring communities of Lompoc, Santa Maria, and Santa Ynez will receive specific impacts associated with MX operations. Expenditures on direct operations and maintenance personnel and on consumables required will stimulate the local and regional economies through direct and indirect increases in earnings and jobs. The new jobs will reduce unemployment, encourage in-migration of workers and impact the housing market, transportation system, and the general community infrastructures.

Because MX testing may be taking place during the same time frame as Space Shuttle testing operations, the combined impacts of the two programs will be covered as well as those for MX alone. Proposed LNG plant operations are not covered in this section since the LNG project will have a modest sized work force, about 90 people, and introduction of the small associated impacts would not be productive.

In addition to operations impacts, some construction impacts which affect Vandenberg and its environs are incorporated into this section, including: traffic, air quality, noise, and water resources.

Projected Growth without the Project (3.3.1)

Population Dynamics (3.3.1.1). Historic trends, as well as current and projected populations for areas where MX construction and flight test personnel are expected to live, are relevant to analysis of population effects. As such, the discussion of population dynamics for Santa Barbara County will be concerned with countywide historic, current, and projected population distribution.

Countywide Population Growth (3.3.1.2). Santa Barbara County is currently the sixteenth most populous county in California, accounting for 1.3 percent of the total state population. According to the California Department of Finance, estimated total population in the county was 286,500 in July 1976, an increase of approximately 20,800 or 7.8 percent since 1970, for a corresponding annual growth rate of 1.8 percent.

In October 1975, the California Department of Finance conducted a county-wide special census for Santa Barbara County. The special census, where data are more detailed and accurate than intercensus estimates, showed 280,605 people in the county. The annual growth of 1.2 percent in the period 1970 to 1975 is a much slower growth rate than in the prior decade, when the development of Vandenberg, expansion of the University of California at Santa Barbara, and the growth of research and development and manufacturing firms spurred a population increase of 4.6 percent annually. Table 3-21 traces this growth from 1940 to 1976.

North County Population Growth (3.3.1.3). Historic population trends of the Lompoc and Santa Maria valleys can be attributed to three major factors: geographic isolation, economic prosperity, and activity at Vandenberg during the last two decades.

Table 3-21. Population growth in Santa Barbara County, 1940 to 1976.

DATE	POPULATION	ANNUAL GROWTH RATE (PERCENT)
U.S. Census		
1940 April 1	70,555	—
1950 April 1	98,220	3.4
1960 April 1	168,962	5.6
1970 April 1	264,324	4.6
1975 October 23 (Special Census) ¹	280,605	1.2
California Department of Finance Estimates		
1970 July 1	265,700	0.9
1971 July 1	268,700	1.1
1972 July 1	272,400	1.4
1973 July 1	275,000	1.0
1974 July 1	279,200	1.5
1975 July 1	281,300	0.8
1976 July 1	286,500	1.8

¹California Department of Finance, 1976.

Source: Employment Development Department, 1977.

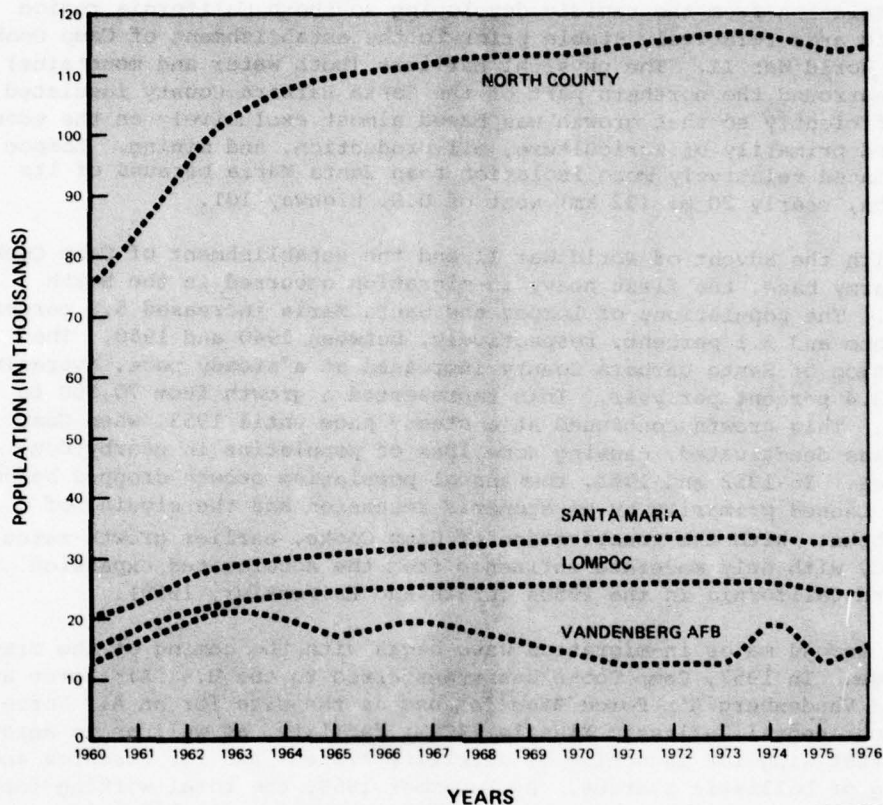
Isolation from the rapidly developing southern California region left the area relatively stable prior to the establishment of Camp Cooke during World War II. The physical barriers (both water and mountains) which surround the northern part of the Santa Barbara County insulated it sufficiently so that growth was based almost exclusively on the economy, composed primarily of agriculture, oil production, and mining. Lompoc experienced relatively more isolation than Santa Maria because of its location, nearly 20 mi (32 km) west of U.S. Highway 101.

With the advent of World War II and the establishment of Camp Cooke as an army base, the first heavy in-migration occurred in the North County. The populations of Lompoc and Santa Maria increased 5.0 percent per annum and 2.1 percent, respectively, between 1940 and 1950. The population of Santa Barbara County increased at a steady pace, averaging about 3.4 percent per year. This represented a growth from 70,500 to 98,220. This growth continued at a steady pace until 1953, when Camp Cooke was deactivated, causing some loss of population in nearby communities. In 1952 and 1953, the annual population growth dropped below 2,000, caused primarily by an economic recession and the closing of Camp Cooke. With the reactivation of Camp Cooke, earlier growth rates resumed, with only moderate influence from the accelerated expansion of southern California in the 1950s (Crain and La Perrier, 1959).

A second major in-migration wave began with the coming of the missile age. In 1957, Camp Cooke was transferred to the U.S. Air Force and renamed Vandenberg Air Force Base for use as the site for an Air Force Intercontinental Ballistic Missile (ICBM) facility, as well as an aerospace test wing for launching of satellite systems and for research and testing of ballistic systems. By November 1959, the total working force of the base (military, civil service, contractor) was 12,505, plus a dependent population of 40,023 (Vandenberg AFB, 1959). The work force peaked at about 20,000 in the early 1960s.

This increase in the working force at the base as well as the induced regional economic growth which resulted, had an effect on population growth in Santa Barbara County, particularly in Lompoc and Santa Maria. From 1957 to 1966, Lompoc quadrupled in population to 24,625 (Lantis, Steiner, and Karinen, 1973), while Santa Maria grew from 18,000 in 1957 to 31,000 in 1965 (Koebig and Koebig, 1968). Figure 3-11 summarizes growth since 1960 in the North County.

South Coast Population Growth (3.3.1.4). In the South Coast, the introduction of a number of electronics and research and development firms in the Santa Barbara-Goleta area (some of them related to activity at Vandenberg) provided a boost to the economic base of that area. The Goleta Valley sustained the largest increase, tripling its 1960 population to 60,184 in 1970. Table 3-22 shows the growth of the city of Santa Barbara since 1920. Because development areas such as Goleta have not incorporated or been annexed, there has been a continuing decline in the percentage of urban population.



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Figure 3-11. Comparative population change in Santa Barbara County, 1960 to 1976 (Santa Barbara County Board of Supervisors, 1974; Vandenberg AFB, 1974, 1975, 1976; California Department of Finance, 1976; Santa Barbara County Planning Department, 1978).

Prior to the 1960s, Santa Barbara's position as the dominant residential area was largely unchallenged. In 1960, about two-thirds of the South Coast population lived in the city. Carpinteria and Montecito each held about 7 percent of the local population, while about one person in five lived in the Goleta Valley. By 1970, Santa Barbara was being strongly challenged by Goleta, which had doubled its share of total South Coast population. The other three areas declined in relative population, although all areas were growing. The Goleta Valley achieved a prominent position because it grew at an extremely rapid average of 22 percent per year. Much of this growth resulted from space exploration-related industries stimulated by activities at Vandenberg. Also, they were drawn to the South Coast by the University of California at Santa Barbara

Table 3-22. Population and rate of growth in the city of Santa Barbara, 1920 to 1975.

YEAR	POPULATION	INCREASE	ANNUAL GROWTH RATE (PERCENT)
1920	19,441	7,782	5.2
1930	33,613	14,172	5.6
1940	34,953	1,345	0.4
1950	44,854	9,955	2.5
1960	58,763	13,855	2.7
1970	70,215	11,447	1.8
1975	72,238	2,023	0.6

Sources: Bureau of Census, 1973; California Department of Finance, 1976. ^{372T-3039}

(UCSB). However, the buildup of UCSB and aerospace industries occurred at about the same time, making cause-and-effect relationships impossible to describe.

While cause and effect cannot be determined, the 1949 decision to supply Lake Cachuma water to the Goleta Valley also had at least an accommodating effect on growth of the area. In recent years, the relative growth to Goleta has continued from 1970 to 1975, in spite of a moratorium on new water hookups.

Santa Barbara continued its decline in relative population, while Montecito stabilized and Carpinteria continued its growth. These changes in relative population tend to obscure the fact that all four areas were growing, although Santa Barbara had slowed to a minimal 0.6 percent per year. During this most recent period, Carpinteria was the fastest growing local area (at 4.8 percent per year), and both Goleta and Montecito grew at annual rates of 2.7 percent, about half the rate in Carpinteria. Santa Barbara has become the slowest growing South Coast planning area. Relative to the 1960 and 1970 period, the 1970 to 1975 growth rate in Carpinteria remained stable, Montecito increased over half, Goleta declined to 12 percent of its earlier level, and Santa Barbara declined to about one-third of its earlier level. Table 3-23 summarizes the growth changes in the South Coast in 1960 to 1970 and in the 1970 to 1975 time period.

Table 3-23. Average annual growth rates in South Coast planning areas.

PLANNING AREA	AVERAGE ANNUAL GROWTH RATE	
	1960 TO 1970	1970 TO 1975
Carpinteria	4.6	4.8
Montecito	1.6	2.7
Santa Barbara	1.9	0.6
Goleta	21.6	2.7
Total South Coast	6.1	2.1

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The overall slowing in rate of growth is dramatic and stems from both a diminishing household size and rate of natural increase. Countywide, the birthrate has been about 1.8 births per woman. The North County has recorded about 2.7 births per woman, while the South Coast, with its large retired and student populations, has recorded only 1.5 births per woman.

The countywide change from 1960 to 1975, with a special focus on the elements of the North County, is shown in Table 3-24. The North County, as a whole, grew less rapidly than the South Coast or the total county, but Lompoc and Orcutt exhibited growth rates larger than those for the county, the South Coast, or the North County total.

Table 3-24. Population change in Santa Barbara County, 1960 to 1975.

PLANNING AREA	1960	1970	1975	1960 TO 1970 AVERAGE ANNUAL GROWTH RATE	1970 TO 1975 AVERAGE ANNUAL GROWTH RATE
North County	75,707	113,899	114,295	4.1	0.1
Lompoc Valley	28,234	47,729	43,887	5.4	-1.7
Lompoc	17,194	31,163	30,271	6.1	-0.6
Vandenberg	11,040	16,566	13,616	4.1	-3.9
Santa Maria Valley	39,667	56,630	58,018	3.6	0.5
Santa Maria	23,938	33,295	33,875	3.3	0.3
Orcutt	11,539	19,477	20,335	5.4	0.9
Guadalupe	4,190	3,858	3,808	0.8	-0.3
Santa Ynez Valley	6,462	8,328	11,250	2.6	6.2
Central Valley	1,344	1,212	1,140	-1.0	1.2
South Coast	95,145	153,661	166,310	6.1	2.1
County Total	168,962	264,324	290,605	4.5	1.2

Sources: Wallace et al., 1975; California Department of Finance, 1976.

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Alternative Growth Scenarios (3.3.1.5). As part of its work on a new general plan for the county of Santa Barbara, Livingston and Associates developed population projections for three alternate growth scenarios. Their projections for 1990, by planning area, are shown in Table 3-25.

The assumptions behind the high-growth scenario include an aggressive campaign by the county to encourage economic development and agricultural growth. State project water would be imported by the mid-1980s, the Space Shuttle would be in operation at Vandenberg by 1980-1981, and UCSB enrollment would grow to 16,000 by 1990. For the North County,

Table 3-25. Population projections to 1990 for Santa Barbara County and its planning areas.

PLANNING AREA	1975 SPECIAL CENSUS	ALTERNATE GROWTH SCENARIOS 1990 POPULATION PROJECTIONS		
		HIGH	MODERATE	RESTRICTED
North County				
Santa Ynez	11,250	13,893	12,115	12,085
Lompoc	30,271	41,386	35,070	34,980
Vandenberg	13,616	16,380	15,430	15,390
Santa Maria	33,875	43,872	37,875	37,780
Orcutt	20,335	24,715	21,300	21,245
Guadalupe	3,808	4,680	4,340	4,325
Cuyama	1,140	1,460	1,400	1,400
Subtotal	114,295	146,386	127,530	127,205
South Coast				
Carpinteria	13,084	20,064	16,330	15,320
Montecito	8,954	12,084	11,260	9,750
Santa Barbara	74,608	91,100	85,410	77,650
Goleta	69,664	104,566	82,800	71,395
Subtotal	166,310	227,814	195,800	174,115
Total County	280,605	374,240	323,330	301,320

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Sources: California State Department of Finance, 1976; Livingston and Associates, 1976.

this would result in an average annual growth rate of 1.7 percent from 1975 to 1990. For the South Coast, the growth rate would be 2.1 percent per annum, and for the county as a whole, the rate would be about 1.9 percent.

With the moderate-growth scenario, economic growth would not be actively pursued, nor would growth controls be imposed. State Project water importation would not take place by 1990, and the Space Shuttle program would be delayed. Here, the North County growth rate is about 0.7 percent per year, the South Coast about 1.1 percent, and the whole county about 0.9 percent per year over the 15-year time period.

The restricted-growth scenario involves implementing growth controls which would limit growth in the South Coast to no more than natural (births minus deaths) increase; net in-migration would be stopped. In the North County, growth rate would be similar to that in the moderate-growth scenario (0.7 percent). For the South Coast, the rate drops to about 0.3 percent, and for the county as a whole, the growth is about 0.5 percent per year from 1975 to 1990.

The moderate-growth scenario is most compatible with local preferences, excepting that projected growth in Lompoc is below local preferences. Of the three scenarios, the moderate-growth scenario will probably come closer to representing the future (Livingston and Associates, 1976).

Employment Projections by Industry (3.3.1.6). A total of 30,281 workers are expected to join the county ranks of wage and salary employees between 1971 and 1990. The largest increase of 8,120 workers, or 26.8 percent of the total increase, will occur in the services sectors, followed by retail trade with 22.7 percent, and education with 15.4 percent. The mining sector is expected to lose 175 workers between 1971 and 1990.

A comparison between the North County and the South Coast shows large variations in some sectors. For example, the services sector accounts for 31.4 percent of the additional work force on the South Coast compared with only 15.0 percent in the North County. On the other hand, construction and agricultural sectors account for a larger portion of the additional workers in the North County. The relative values for construction are 8.5 percent in the North County and only 4.0 percent of all workers in the South Coast. Similarly, corresponding values for agriculture are 9.3 percent and 0.1 percent in the North County and the South Coast, respectively (see Table 3-26).

The moderate-growth scenario, for Santa Barbara County estimates that total employment in the county in 1980 will be 110,430, composed of 69,700 in the South Coast and 40,730 in the North County. For 1990 total employment is estimated to be 129,740, of which 83,700 is located in the South Coast, and 46,040 in the North County (Livingston and Associates, 1976). The Bureau of Economic Analysis estimates total 1980 employment at 131,400 and 149,400 for 1990 (BEA, undated). Given that the two sources used

Table 3-26. Net additions in wage and salary employees with moderate growth, 1971 to 1990.

SECTOR	NORTH COUNTY	SOUTH COAST	TOTAL
Agriculture	787	15	802
Mining	-112	-63	-175
Construction	716	872	1,588
Manufacturing	100	998	1,098
Transportation, Communi- cation, and Utilities	459	952	1,411
Wholesale Trade	596	1,093	1,689
Retail Trade	2,365	4,501	6,866
Finance, Insurance, and Real Estate	220	1,173	1,393
Services	1,272	6,848	8,120
Education	1,470	3,205	4,675
Government	589	2,225	2,814
Total Additions	8,462	21,819	30,281

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Source: Livingston and Associates, 1976.

different projection methodologies, the divergence of their results is not surprising. Since the Livingston and Associates includes local policy decision, their estimates are used herein.

Earnings Projections (3.3.1.7). The Bureau of Economic Analysis has prepared projections of earnings by industry for all Standard Metropolitan Statistical Areas (SMSAs), including Santa Barbara. The projections, made in constant 1967 dollars, are based on historical data going back to 1950, and include estimates to 1980 and 1990 (Table 3-27). The countywide birthrates may increase since the low level may present only a postpone-ment of childbearing, so the projection must be viewed as conjectural. The projections here envisage an even greater dominance of services (37.1 per-cent of total earnings by 1990), with trade at 16.9 percent and manufacturing at 10.4 percent, a relative decline. Government is seen as an increasing share, state and local government in particular.

Table 3-27. Earnings by industry, personal income, employment and population for Santa Barbara County (1967 \$ thousands).

INDUSTRIAL DIVISION	1950		1969		1971		1980		1990	
	AMOUNT	PERCENT	AMOUNT	PERCENT	AMOUNT	PERCENT	AMOUNT	PERCENT	AMOUNT	PERCENT
Agriculture/Fishing, Forestry	48,432	21.71	30,375	4.44	32,122	4.66	26,500	2.21	23,500	1.75
Mining	1,978	0.89	10,575	1.55	8,626	1.25	7,400	0.62	7,300	0.55
Construction	13,794	6.18	45,713	6.68	38,141	5.53	61,600	5.14	87,900	6.56
Manufacturing Durable and Non-Durable	30,543	13.69	94,943	13.88	83,793	12.16	111,100	9.27	138,700	10.35
Transportation, Communications, and Public Utilities	9,719	4.36	27,765	4.06	28,649	4.16	46,400	3.87	68,500	5.11
Wholesale-Retail Trade	44,439	19.92	106,157	15.51	111,694	16.20	165,000	11.93	216,800	16.93
Financial, Real Estate, and Insurance	7,778	3.49	26,423	3.86	27,864	4.04	49,000	4.09	77,800	5.81
Services	38,936	17.45	168,167	24.57	175,151	25.41	318,400	26.55	497,000	37.10
Government Federal	5,016	2.25	35,444	5.18	36,809	5.34	54,800	4.57	82,500	6.16
State/Local	15,510	6.95	93,447	13.66	105,498	15.30	183,400	15.29	288,200	21.51
Military	6,940	3.11	45,216	6.61	41,009	5.95	64,400	5.37	94,100	7.02
Total Personal Income	273,632		853,373		888,646		1,406,900		2,062,500	
Total Employment	39,130		-		102,985		131,400		149,400	
Population, Midyear	99,062		261,991		268,077		307,600		349,300	
Total Earnings	\$223,085	100	\$684,225	100	\$689,356	100	\$1,088,000	100	\$1,582,300	100

Source: Bureau of Economic Analysis, undated.

3721-3045

Socioeconomic Impacts of the Project (3.3.2)

The socioeconomic impacts of the MX project at Vandenberg result from new investment which creates new jobs in the area. These jobs attract new residents to the area who require housing for themselves and their families, schools for their children, highways for transportation, commercial establishments to supply their needs, and a variety of other responses from public and private sectors. While the driving force for this expansion is direct and indirect economic stimulation, the most visible manifestation is population growth.

To present a more complete view of MX-related impacts, earnings, employment, and further effects associated with two major projects in the same time frame will also be covered: the proposed LNG plant near Pt. Conception and the Space Shuttle program at Vandenberg. The economic, population, and housing data relating to Shuttle impacts during construction differ significantly from data reported in the Shuttle FEIS. These differences reflect the most accurate current data available for the Shuttle.

Construction Phase (3.3.2.1). Changes in the local economy, particularly new jobs, can cause a variety of associated changes in other portions of the regional infrastructure including population, housing, schools, and services. The following discussion estimates the economic changes likely to result from MX construction so that subsequent community impacts can be estimated.

Economic effects result from Air Force expenditures for three categories of facilities or activities during the construction phase. These were detailed in Section 1.1 and are summarized as:

Support facilities	\$28,783,000
Basing mode facilities	
Hybrid trench option	\$12,716,000
Shelter option	\$ 1,385,000
Activation	\$26,100,000

Only one of the two basing mode options above will be provided, so construction costs are in the range of \$30 to \$40 million and activation is another \$26 million. While subject to revision, these estimates are sufficient to estimate project effects and impacts.

Total effects include both direct and indirect effects. The creation of new jobs in the county for people working directly on the project will also result in the creation of indirect jobs in support industries throughout the county. Direct and indirect effects in terms of both earnings and jobs are summarized in Table 3-28. Total earnings and total jobs were computed through the RIMS procedure (Appendix K), with separate multipliers developed for each aspect of the project: for construction of hybrid trench; for construction of shelters; and for activation.

Table 3-28. Estimated economic effects occurring in Santa Barbara County from MX facilities construction at Vandenberg AFB (\$ millions).

ECONOMIC EFFECT	CONSTRUCTION			ACTIVATION	TOTAL	
	SUPPORT FACILITIES	BASING MODE ³			TRENCH	SHELTER
		TRENCH	SHELTER			
Cost ¹	28.8	12.7	1.4	26.1	67.6	56.3
Earnings ²						
Direct	8.3	2.2	0.6	11.6	22.1	20.5
Indirect	7.2	3.0	0.3	8.8	19.0	16.3
Total Earnings	15.5	5.2	0.9	20.4	41.1	36.8
Jobs						
Direct	314	87	23	580	981	917
Indirect	605	247	22	1,120	1,972	1,747
Total Jobs	909	334	45	1,700	2,953	2,664

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¹Estimated Air Force expenditures in Santa Barbara County.

²Includes pay and benefits for workers, and proprietors income.

³Only one basing mode to be selected.

Support facilities and activation are common to either basing mode and are the major cost items. Thus, while there is a marked difference in the cost of basing mode facilities, the total effect is a much lesser difference in terms of either earnings (about \$4 million) or jobs (about 300 jobs). These differences are about 10 percent of the trench basing mode total effect.

Essentially all of the direct jobs and associated earnings will occur in North County; but the nature of economic interaction will result in a substantial portion of the indirect jobs occurring on the South Coast. If trench basing mode is selected, about 300 indirect jobs will occur on the South Coast, while the selection of shelter basing mode will result in about 130 jobs on the South Coast.

Earnings (3.3.2.1.1). Analysis of the significance of the economic effects (i.e., analysis of the impacts) is complicated by the potential for two unrelated projects occurring in the vicinity: The Liquid Natural Gas (LNG) terminal and the Space Shuttle facilities. As was shown in Section 1.2, total earnings in the county by 1980 are projected to be \$1,008 million (1967 dollars) and North County's share of the total will approximate \$435 million. The peak activity year for MX will be 1982 (after the activation has begun) when MX related earnings will approach \$14 million (1967 dollars) countywide and \$10 million in North County (Table 3-29).

Table 3-29. Relative impact of proposed construction projects on earnings in the peak MX activity year (1982) (1977 \$ thousands).

PROJECTED BASE AND PROPOSED PROJECTS	NORTH COUNTY		ENTIRE COUNTY	
	DOLLARS	PERCENT OF BASE	DOLLARS	PERCENT OF BASE
Projected Base	453.2	100.0	1,088.0	100.0
MX	9.6	2.2	13.6	1.2
Shuttle	17.4	4.0	23.9	2.2
LNG	6.4	1.5	10.9	1.0

¹Projection to 1980.

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Therefore, in 1982, MX will increase local earnings about 1 percent county-wide and 2 percent in North County. 1981 and 1983 will each result in lesser activity levels for MX. Viewed apart from the other unrelated projects, this would amount to a growth stimulus for a short period of time.

MX should, however, also be viewed as a cumulative source of growth together with LNG and the Shuttle. Assuming current schedules hold, Shuttle and LNG projects peak in 1980, but considerable activity continues into 1982 when MX peaks.

By 1982, LNG construction is anticipated to have fallen to about 20 percent of 1980 levels while the Shuttle will have fallen to 40 percent of peak levels. In terms of earnings, the Shuttle will continue as the largest single source of new earnings in the county (as is true throughout the 1978-1983 period), the MX construction will be second, and LNG third.

As noted, both LNG and the Shuttle will experience their peak construction year in 1980, decline somewhat in 1981 and decline dramatically, but to still substantial levels, in 1982. MX starts in 1981, doubles in 1982, and then declines to half the 1981 level in 1983. In 1980, the overall peak year, LNG and Shuttle activities respectively represent 9 and 10 percent increases in projected North County earnings without the projects. MX can partially be viewed as minimizing the decline in other projects. By itself, MX is a notable increase in projected earnings. The significance of this increase is more important because of the cumulative effect with unrelated projects. This cumulative effect also affords MX the position of a mitigation for the other projects.

Employment (3.3.2.1.2). As with earnings, the impact on employment that can be attributed to MX is complicated by LNG and Space Shuttle activities. The cumulative employment effects resulting from the MX, LNG and Shuttle projects and impacts without MX have been estimated by year and the results are shown in Figure 3-12. Total jobs resulting from the LNG and Shuttle projects peak at about 11,500 in 1980. In 1981, when the MX program starts, jobs relating to LNG and Shuttle decline by about 1,300 workers, but MX adds about 1,000 workers negating some of the loss. Although MX expands in the following year, it can offset only part of LNG/Shuttle combined drop of more than 5,000 jobs, firstly because MX total requirements are much lower, peaking at about 1,600 in 1982, and secondly because the job skills required by MX are not entirely comparable to the LNG/Shuttle programs, especially during the MX operations phase when as many as 580 military, engineering and scientific personnel will replace construction personnel.

By 1980, between 110,000 and 130,000 jobs (not including the three projects) will exist in the county, so each year MX employment will be

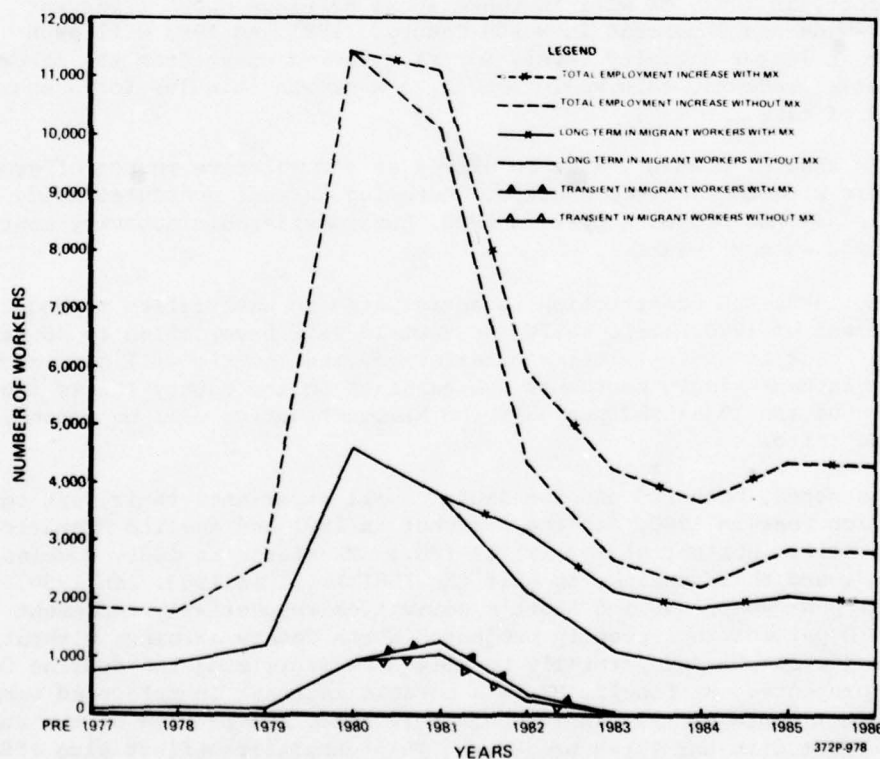


Figure 3-12. Annual employment changes generated by MX and other projects (LNG and Shuttle) in Santa Barbara County, 1978-1986.

less than 1.5 percent of the county total. No quantitative estimate is possible, but many of the new jobs from MX/LNG/Shuttle would go to currently unemployed workers in the county. This is particularly true since most of the MX/LNG/Shuttle jobs would be in construction, manufacturing, services, and trade, particularly retail trade, and these are exactly the sectors showing the most widespread and persistent unemployment in the county over the 1971-1975 period (see Section 1.2.2.3). However, LNG and Shuttle start earlier than MX and therefore place prior claims on the local unemployment work force. This may result in the importation of almost all the MX construction phase workers from outside the county, particularly from the Los Angeles region.

Population (3.3.2.1.3). Santa Barbara County will experience at least two kinds of population change as a result of MX and the two concurrent projects (Space Shuttle and LNG):

- Short-term growth from the importation of construction labor. These people will likely be drawn from the Los Angeles region, will maintain homes and families in that area, and will require temporary housing in the project vicinity.
- Long-term growth from the importation of activation personnel and indirect and induced growth related to economic stimulation. A portion of this need will be met from existing local unemployment and changes in the labor force participation rate and a portion from people in-migrating from across the country. These job holders will relocate their families and will require permanent housing in the project area.

Construction labor requirements for MX peak in 1980, so that year has been selected for analysis here. (See Figure 3-12 in the employment section for details.) Shuttle and LNG projects are assumed to be in progress in that year and will lay a prior claim on the locally available construction craftsmen. It is, therefore, assumed that all MX construction workers will have to be imported. Some may be employed on MX for as long as two years, but most will be employed for a period of weeks or at the most a few months.

At the peak in 1981, MX will employ 200-250 construction workers. At the same time, LNG project may import 700-750 and Shuttle, 90-140 construction workers (total employment is, of course, higher for these projects). Since short-term construction workers are not expected to relocate families, the population increase in the Santa Barbara and San Luis Obispo counties would amount to a cumulative total of 990-1,140 persons with 200-250 attributable to MX (Table 3-30).

To these estimates should be added the estimates of population growth caused by the importation of activation personnel for Space Shuttle and indirect and induced workers related to economic stimulation. In 1981,

Table 3-30. In-migrant population distribution by planning area, 1981.

PLANNING AREA	LNG		SHUTTLE		MX		TOTAL	
	TEMPORARY ¹	LONG-TERM ²	TEMPORARY ¹	LONG-TERM ²	TEMPORARY ¹	LONG-TERM ²	TEMPORARY ¹	LONG-TERM ²
Lompoc	170-180	350-430	20-30	1,300-1,550	50-60	55-80	240-270	1,705-2,060
Santa Maria/Orcutt	170-180	650-840	20-30	1,650-1,950	50-60	100-150	240-270	2,400-2,940
Santa Ynez Valley	80-90	100-130	10-20	350-400	20-30	15-30	110-140	465-560
North County	420-450	1,100-1,400	50-80	3,300-3,900	120-150	170-260	590-680	4,570-5,560
South Coast	140-150	1,500-1,900	20-30	2,400-2,800	40-50	280-340	200-230	4,180-5,040
Santa Barbara County	560-600	2,600-3,300	70-110	5,700-6,700	160-200	450-600	790-910	8,750-10,600
San Luis Obispo County	140-150	-	20-30	-	40-50	-	200-230	-
Total	700-750	2,600-3,300	90-140	5,700-6,700	200-250	450-600	990-1,140	8,750-10,600

¹A variety of assumptions have been used in these projections. MX imports 100 percent of construction craftsmen, LNG 50 percent, and the Shuttle 20 percent. Distribution to areas are based on 60 percent to North County and 20 percent each to the South Coast and San Luis Obispo County. Within North County, Santa Maria and Lompoc each receive 40 percent while 20 percent go to the Santa Ynez Valley (primarily Buellton). These assumptions are consistent with historic patterns in the area.

²Long-term in-migrants consist of 758 activation workers (for Shuttle), 50 percent of the indirect and induced workers and the families of all workers.

MX-related indirect and induced population migration into the project area will add 450-600 persons to the region's population while the cumulative effect of all the three projects may be an addition of 8,750-10,600 long-term residents (Table 3-30).

As a whole, the temporary and permanent population in-migration will have varying degree of impact on the various planning areas of Santa Barbara County. While population increase due to MX project will be in the range of only 0.2-0.5 percent of the projected 1981 population with no projects, the cumulative impact of the three projects, if they proceed on schedule, could be 3.2-3.9 percent countywide, and the planning areas of the North County could experience increases of 4.7 to 7.2 percent (Table 3-31).

Table 3-31. Comparative population change due to MX and cumulative effect of MX, LNG, and Shuttle, 1981.

PLANNING AREA	BASLINE PROJECTIONS 1981 (without MX, LNG, or Shuttle) ¹	POPULATION CHANGE, DUE TO MX	PERCENT POPULATION CHANGE, DUE TO MX	CUMULATIVE POPULATION INCREASE (MX, LNG, SHUTTLE)	PERCENT POPULATION CHANGE (CUMULATIVE)
Lompoc	32,191	105-140	0.3-0.4	1,945-2,330	6.0-7.2
Santa Maria/Orcutt	56,196	150-210	0.3-0.4	2,640-3,210	4.7-5.7
Santa Ynez Valley	11,598	35-60	0.3-0.5	575-700	5.0-6.0
North County	119,587	290-410	0.3-0.4	5,160-6,240	4.3-5.2
South Coast	178,106	320-390	0.2-0.3	4,380-5,270	2.5-3.0
Santa Barbara County	297,695	610-800	0.2-0.3	9,540-11,510	3.2-3.9

¹Baseline projections are interpolated from 1975 populations of the planning areas and the 1990 projections (moderate growth scenario) of Livingston and Associates, 1976.

Most of the population increase in the county as well as in the Planning Areas will occur by 1980, a year before MX project starts (see Figure 3-12 in the employment section). In 1981, Shuttle and LNG construction labor requirements start a steep decline. The MX project will slow this decline by providing employment to some workers no longer needed on the other projects. No population in-migration should be necessary, to fill MX-related indirect and induced jobs. There will be an increase of 200-250 MX construction workers requiring transient housing; this is in addition to the transient workers from the Shuttle and LNG projects which will be the source of additional impact on the housing market.

Housing (3.3.2.1.4). Housing requirements fall into two general categories: housing for transient or temporary construction craftsmen and housing for in-migrating permanent direct and indirect jobholders. The former constitutes a demand primarily on mobile-home parks, motels, and apartment units. The latter demands will be concentrated in apartments and purchase homes.

Transient Housing. The transient craftsmen estimates are provided in Table 3-32. How this demand may be accommodated is discussed in this section.

Motel rooms are abundant throughout the region, but demands from tourism frequently fill the units. Tourism demands tend to peak on weekends when project demands will probably slacken, as workers commute to permanent homes for the weekend. However, the cost of motel rooms probably means only a small portion of the workers will use this alternative.

Apartment units are also common in the region, but vacancy rates tend to be low (1 to 3 percent). Further, these would probably be used only by construction workers with relatively long-term jobs (several months), and this is a small portion of the total.

Mobile homes and recreation vehicles are a major source of housing for transient construction workers. In Santa Barbara County, these would have to be parked in approved trailer parks and space for short-term residents is very limited (see Section 1.2.2.3.3 and 1.2.2.3.4). Means of handling this impact for LNG and the Shuttle are not yet developed, but they are important to assess MX impacts because the peak for combined LNG and Shuttle construction workers is 1980. The combined peak for MX/LNG/Shuttle is 1981 and lower than the 1980 peak. Thus, the mitigation used for 1980 could be extended to cover the lesser impacts in 1981. It is likely that some form of temporary recreational vehicle park camps will be necessary, but until these other projects are more fully planned, the possible relationship with MX cannot be assessed. Recreation vehicles

Table 3-32. Transient housing demands by project and area, 1981.

AREA OF TEMPORARY RESIDENCE ¹	PROJECT			TOTAL
	MX	SHUTTLE	LNG	
Lompoc	50-60	20-30	170-180	240-270
Santa Maria/Orcutt	50-60	20-30	170-180	240-270
Santa Ynez Valley	20-30	10-20	80-90	110-140
North County Total	120-150	50-80	420-450	590-680
South Coast Total	40-50	20-30	140-150	200-230
Santa Barbara County Total	160-200	70-110	560-600	790-910
San Luis Obispo County Total	40-50	20-30	140-150	200-230
Total - Both Counties	200-250	90-140	700-750	990-1,140

¹Distribution of transient workers follows historic patterns of construction worker projects (see population section).

are travel trailers, campers, and motor coaches used as temporary housing and generally self-contained as far as sanitation and water are concerned. They are not mobile homes that are generally permanently parked at a mobile home park and which require external connections for water and wastewater. About 200-250 workers are involved but some will find accommodations in existing rental areas and some will live 2 or 3 to a recreational vehicle. New on- or offbase parking areas for 75 to 100 recreational vehicles will be sufficient to offset the increase in demand for housing of this type. Such parks must be built to state and county standards and if placed on private property, require a special zoning permit and environmental review.

There are no present plans to provide such a parking area although one is suggested as a mitigation. The Air Force and local agencies will have to develop details as schedules for MX and the Shuttle become more firm. Most of the construction workers who relocate to the area will be drawn from Los Angeles, will drive self-contained recreational vehicles (motor homes), and will return to their permanent residences on weekends. The boom town construction camp typical of some western energy developments will not occur since adequate local services and facilities exist and families will not be present.

Permanent Housing. Additional housing needed for the more permanent jobholders and their households by 1981 are projected in Table 3-33. A household size of 2.7 was used to convert population increases related to direct labor requirements to households. For indirect workers a household size of 2.6 was used. It can be seen that a rough equivalence between the units required for the three projects in this peak year and the total projected increase without the projects in the entire North County and its planning areas is estimated to be 2,000 units in each case. This unusual result comes from three major projects peaking at close to the same time.

The upsurge in housing unit demand is a function of the present schedules of the three projects. The schedules are not firm at this time, so the likelihood of coincident peaking is suspect. Without coincident peaking, growth would still occur, but it would be less precipitous and more easily managed. Should the coincident peaking occur, the upward pressure on housing prices and rents could be relatively intense, and they would probably come closer to price levels reached in the South Coast in recent years.

Table 3-33. Permanent housing units required in Santa Barbara County in 1981 by project.

AREA	EXISTING UNITS (1975) ²	PROJECTED INCREASE BY 1981 ³	PROJECT-RELATED REQUIREMENTS		
			MX	SHUTTLE	LNG
Lompoc	11,565	740	20-30	525-575	130-160
Santa Maria-Orcutt	18,548	760	40-60	650-700	250-300
Santa Ynez Valley	4,548	130	5-10	125-150	40-50
North County Total ¹	36,261	2,000	65-100	1,300-1,425	420-510
South Coast Total	65,667	4,500	110-130	950-1,000	600-700
Santa Barbara County Total	101,928	6,500	175-230	2,250-2,425	1,020-1,210

¹Also includes Guadalupe and Cuyama Valley portions of North County.

²State of California, Department of Finance, 1976.

³Based on Livingstone and Associates, 1976.

In both Lompoc and Santa Maria, the addition of multifamily units generally exceeded single-family units during the early 1970s. This was true for the cities of Santa Barbara and Carpinteria in 1971 to 1972 and 1973 to 1974, but 1975 to 1976 saw a reversal. This reversal was also true for countywide data. The 1975 Census revealed that the South Coast had about 55 percent of its housing in single-family units, while in the North County, 72 percent were single-family units. Some shrinkage of this portion in the North County seems to be occurring, so that units in multiple will increase their share of the market, but the overall percentages are not expected to change dramatically over the 1975 to 1981 time interval. For housing the future population generated by the projects, the increase in multiples creates a larger market for rentals or condominiums. Mobile-home units, too, are increasing, and are increasingly used as permanent homes rather than transient accommodations.

The portion of demand attributable to MX is small. The demand generated by the Space Shuttle, LNG, and MX projects cumulatively is significant, since the 1981 increases projected are a total for 6 years of growth compared to project-induced demand expected to be concentrated in 1 or 2 years. This increase is not so large as to overwhelm the long-term permanent housing market, although a marked decline in vacancy rates will occur. The extended lead time on new development may create severe short-term supply constraints until developers react to this increase and provide additional units.

Transportation (3.3.2.1.5). The transportation impacts which will result from construction of support and basing mode facilities for the MX project will be felt differently by each of the four available types of transportation service—highway, rail, marine, and air. Highway transportation routes are the most likely to experience the greatest impacts as a result of the construction phase of the MX project.

Highway Traffic. Practically all the highways in the vicinity of Vandenberg will be affected to some degree by the added construction activity on the Base and the new traffic movements made by commuting construction workers.

Table 3-34 shows the anticipated home locations for the workers who will be involved in construction of the MX facility. Some workers can be expected to travel together in carpools, and not all workers will travel during the single highest morning and evening peak hours. In the analysis of commuter traffic, one vehicle per worker is assumed and all trips will be made during the major peak hour. This procedure establishes the maximum effect of the new MX workers on traffic conditions.

Table 3-34. Anticipated location of residence for MX construction workers.

LOCATION	MAXIMUM NUMBER OF WORKERS
Lompoc	60
Santa Maria/Orcutt	60
San Luis Obispo County	50
Santa Ynez Valley	30
South Coast	50
Total	250

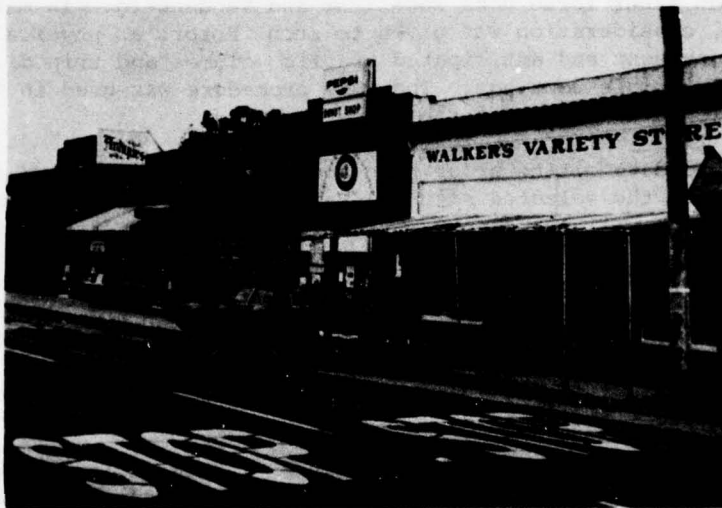
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In analyzing the possible effects of MX construction workers on traffic volumes and travel conditions, logical routings were assigned for trips between labor force home locations and Vandenberg. In making these assignments, consideration was given to such factors as physical roadway conditions, present and anticipated traffic volumes and trip distances via various possible routings. The same procedure was used in determining the anticipated effect of the Space Shuttle.

Four candidate siting areas have been proposed for the MX facilities. The location of the selected site naturally will have a direct bearing on the routes which will be used by workers engaged in construction of the facility. Analysis of onbase roads and gates which can be expected to be used during the MX construction period indicated that the two most northern proposed sites, San Antonio Terrace and Shuman Canyon, would have similar effects on vehicular travel over the existing offbase road network. The effect of the other two sites, Burton Mesa and Lompoc Terrace, however, would be different than that which can be expected if either of the two northern sites is selected.

Tables 3-35 and 3-36 show the estimated increases in peak hour traffic, on individual road segments, which would occur if the MX facility were constructed at one of the four candidate siting areas. As is indicated, the anticipated increases in volumes are all relatively small, with the largest being 140 vehicles or slightly over two per minute. Volume changes of this magnitude normally cannot be identified in the variations which occur in road segment traffic flows. Also shown on the tables, and described below, are the locations of possible congestion due to construction of the MX and Shuttle projects. Vehicle counts normally refer to peak counts per hour.

- Route 246 west of Lompoc. Construction of the MX project at the Lompoc Terrace CSA could be expected to result in congestion along Route 246 west of Lompoc even if the Shuttle were not constructed. If both the MX at Lompoc Terrace and the Shuttle are constructed, widening of this section of roadway probably would be advisable.
- Route 246 in Lompoc. Construction of the MX project at the Lompoc Terrace Site could be expected to add approximately 80 vehicles to the peak hour movement along Route 246 in Lompoc. Although this would result in a total volume 45 vehicles more than the estimated roadway capacity, it is not expected that it would result in congestion which could not be alleviated through staggering worker shifts and traffic control measures.
- Route 246 west of Buellton. The MX project could be expected to add approximately 60 vehicles to the peak hour movement along Route 246 between Lompoc and Buellton if it is constructed at either of the two southern candidate sites. It is not anticipated that there would be a noticeable effect on traffic congestion over that anticipated due to the Shuttle.



Older sections of the community of Orcutt are essentially unchanged from the oil and railroad boom at the turn of the century. Prior to the completion of the four-lane section of S20 in the mid-1960s, approximately 30 percent of the employees at Vandenberg daily commuted past these stores.

Table 3-35. Increased traffic (peak hour volumes) in 1981 due to MX

ROUTE SEGMENT	1981 BASELINE VOLUME	INCREASE DUE TO SHUTTLE CONSTRUCTION	INCREASE DUE TO MX CONSTRUCTION			TOTAL VOLUME: WITH SHUTTLE AND MX CONSTRUCTION			ROADWAY CAPACITY	LOMPOC TERRACE SITE
			LOMPOC TERRACE SITE	BURTON MESA SITE	EITHER OF TWO NORTHERN SITES	LOMPOC TERRACE SITE	BURTON MESA SITE	EITHER OF TWO NORTHERN SITES		
ONE DIRECTION VOLUME										
Route 101 South of Gaviota Pass	1,630	135	15	15	15	1,780	1,780	1,780	2,310	-
Route 101 South of Buellton	1,411	-	-	-	-	1,411	1,411	1,411	2,310	-
Route 101 South of Los Alamos	1,685	1	-	3	47	1,686	1,689	1,733	2,340	-
Route 1 East of East Junction with Route 246	460	192	70	15	15	722	667	667	1,420	-
Route 1 at Santa Ynez River (Lompoc)	1,274	82	-	35	40	1,356	1,391	1,391	2,000	-
Route 1 North of Vandenberg Road (S20)	1,320	275	105	105	88	1,700	1,700	1,683	1,790	-
Route 246 West of Route 1 (Lompoc)	960	185	80	10	5	1,225	1,155	1,150	1,180	45
Route S20 Northwest of Route 1	1,260	124	-	85	58	1,384	1,469	1,442	1,900	-
Route S20 Southeast of Main Gate	595	92	-	73	70	687	760	757	1,900	-
Route S20 Northeast of Main Gate	843	276	105	108	-	1,224	1,227	1,119	1,900	-
Route S20 Southwest of Route 1	850	275	105	105	88	1,230	1,230	1,213	1,900	-
Route 135 North of Route 1	874	275	105	105	88	1,254	1,254	1,237	2,240	-

Table 3-36. Increased traffic (peak hour volumes) in 1981 due to MX

ROUTE SEGMENT	1981 BASELINE VOLUME	INCREASE DUE TO SHUTTLE CONSTRUCTION	INCREASE DUE TO MX CONSTRUCTION			TOTAL VOLUMES WITH SHUTTLE AND MX CONSTRUCTION			ESTIMATED TWO DIRECT WITH SHUTTLE AND MX		
			LOMPOC TERRACE SITE	BURTON MESA SITE	EITHER OF TWO NORTHERN SITES	LOMPOC TERRACE SITE	BURTON MESA SITE	EITHER OF TWO NORTHERN SITES	LOMPOC TERRACE SITE	BURTON MESA SITE	TOTAL
			ONE DIRECTION VOLUMES								
Route 1 South of Lompoc	211	135	15	15	15	361	361	361	501	501	1
Route 1 North of Mission Hills	250	18	-	-	-	268	268	268	434	434	1
Route 1 Northwest of Orcutt	114	-	-	-	-	114	114	114	304	304	1
Route 246 East of Buellton	830	88	35	35	-	953	953	918	1,506	1,506	1
Route 246 West of Buellton	605	117	65	62	18	787	784	740	1,190	1,187	1
Route 246 West of Lompoc- Casmalia Road	193	57	65	-	-	315	250	250	444	379	1
Route 246 West of Lompoc	420	448	140	17	9	1,008	885	877	1,288	1,165	1
Route 135 West of Los Alamos	42	1	-	5	47	43	46	90	44	47	1
Lompoc-Casmalia Road Northwest of Main Gate	195	3	5	-	70	203	198	268	333	328	1
Lompoc-Casmalia Road South of Casmalia	110	13	5	5	22	128	128	145	201	201	1
Lompoc-Casmalia Road Northwest of Route 246 (Lompoc)	180	60	-	50	18	240	290	258	360	410	1
San Antonio Road East of Route S20	15	1	-	3	22	16	19	38	26	29	1

s) in 1981 due to MX construction (four-lane roads).

SITES WITH CONSTRUCTION		ROADWAY CAPACITY	EXCESS OVER CAPACITY			DEGREE OF TRAFFIC CONGESTION					
EITHER OF TWO NORTHERN SITES	LOMPOC TERRACE SITE		BURTON MESA SITE	EITHER OF TWO NORTHERN SITES	LOMPOC TERRACE SITE		BURTON MESA SITE		EITHER OF TWO NORTHERN SITES		
					LIGHT	HEAVY	LIGHT	HEAVY	LIGHT	HEAVY	
VOLUME											
	1,780	2,310	-	-	-						
	1,411	2,310	-	-	-						
	1,733	2,340	-	-	-						
	667	1,420	-	-	-						
	1,391	2,000	-	-	-			✓		✓	
	1,683	1,790	-	-	-						
	1,150	1,180	45	25	-	✓	✓				
	1,442	1,900	-	-	-						
	757	1,900	-	-	-						
	1,119	1,900	-	-	-						
	1,213	1,900	-	-	-						
	1,237	2,240	-	-	-						

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es) in 1981 due to MX construction (two-lane roads).

SITES WITH CONSTRUCTION		ESTIMATED TWO DIRECTION VOLUMES WITH SHUTTLE AND MX CONSTRUCTION			ROADWAY CAPACITY	EXCESS OVER CAPACITY			DEGREE OF TRAFFIC CONGESTION					
									LOMPOC TERRACE SITE		BURTON MESA SITE		EITHER OF TWO NORTHERN SITES	
EITHER OF TWO NORTHERN SITES		LOMPOC TERRACE SITE	BURTON MESA SITE	EITHER OF TWO NORTHERN SITES		LOMPOC TERRACE SITE	BURTON MESA SITE	EITHER OF TWO NORTHERN SITES	LOMPOC TERRACE SITE		BURTON MESA SITE		EITHER OF TWO NORTHERN SITES	
									LIGHT	HEAVY	LIGHT	HEAVY	LIGHT	HEAVY
TWO DIRECTION VOLUMES														
361	501	501	501	800	-	-	-							
268	434	434	434	320	114	114	114	✓		✓		✓		
114	304	304	304	850	-	-	-							
918	1,506	1,506	1,471	1,150	356	356	321		✓		✓		✓	
740	1,190	1,187	1,143	900	290	287	243		✓		✓		✓	
250	444	379	379	750	-	-	-							
877	1,288	1,165	1,157	800	488	365	357	✓		✓		✓		
90	44	47	91	800	-	-	-							
268	333	328	398	700	-	-	-							
145	201	201	218	650	-	-	-							
258	360	410	378	600	-	-	-							
38	26	29	48	400	-	-	-							

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- Route 246 east of Buellton. The MX project would have minimal effect on the movements along 246 east of Buellton.
- Route 1 (H Street) in Lompoc. The MX project is not expected to affect flows along H Street in Lompoc to any appreciable degree.
- Route 1 north of Mission Hills. The MX project is not expected to alter flows along Route 1 north of Mission Hills.
- Main Gate. Construction of the MX project at either of the two southern candidate sites would further increase the congestion at the Main Gate. Construction at the two northern sites might result in some congestion at the Titan Gate.
- Main Gate Intersection. MX construction at any of the four candidate sites would increase the congestion problem at the intersection adjacent to the Main Gate.
- Pine Canyon Gate Cut-off. A major increase in the congestion problem at the S20 cut-off to the Pine Canyon Gate due to the MX project is not anticipated.

Figure 3-13 shows the locations of 1981 peak hour congestion assuming the Shuttle and the MX are constructed. This can be compared with the 1977 baseline traffic, the projected 1981 baseline traffic, and the 1981 projected traffic with Space Shuttle construction as shown in Figures 3-13, B, and C.

Rail Transportation. Deliveries of many construction materials, such as cement and aggregate, could be made over the Southern Pacific Railroad and the spur to Vandenberg. Final selection of the means of delivery will be determined by the contractor at a later date, but it presently is expected that only aggregate and cement will be delivered by rail, with the rest of the materials coming via trucks. If two to three trainloads per week of material are delivered to the base during the peak period, minimal effects on rail transportation will result. With only two passenger trains and ten freight trains per day using the Southern Pacific line near the base, it would be a simple task to coordinate deliveries of materials to Vandenberg without disturbing normal operations. Air Force personnel and switching engines could be used to move materials around inside the base.

Marine Transportation. Because no movement of materials or personnel is expected to take place via marine transportation, no effects on this transportation mode in the Santa Barbara Channel or at Vandenberg are anticipated.

Air Transportation. The civilian airports most likely to be affected by the construction of the MX launch and support facilities are the Santa Maria Public Airport, the Lompoc Airport, and the Santa Barbara Metropolitan Airport. Since construction materials are expected to be delivered by either highway or rail, the only commercial air traffic generated by the project would be passenger service. The few passengers desiring to fly to the area as a result of the construction phase would probably use the Santa Maria or Santa Barbara airports where commercial service is available.

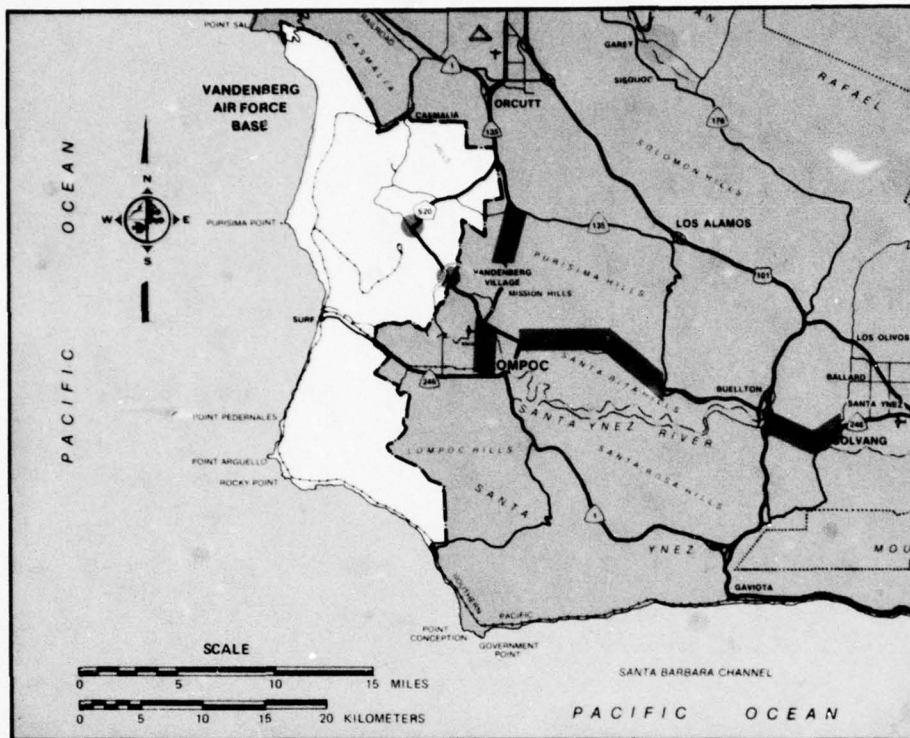
It is anticipated that the commercial airlines flying to Santa Maria or Santa Barbara can easily accommodate additional passengers. Smaller private aircraft would probably land at Lompoc Airport (the closest airport to the base) and military aircraft could land at the base. In either case, the increased air traffic would be slight. A small population growth is projected to accompany MX construction efforts and a similar low growth percentage will probably apply to use of local airports as well. Recently completed remodeling at the Santa Barbara airport is expected to meet air traffic demands for some time. In general, the local airports are expected to be able to accommodate projected air travel demand without further expansion (Santa Barbara County-Cities Area Planning Council, 1975).

At the Vandenberg airfield, the only significant impact of the MX project would be any modification of existing aircraft transfer facilities to facilitate the unloading and transfer of MX-related cargo.

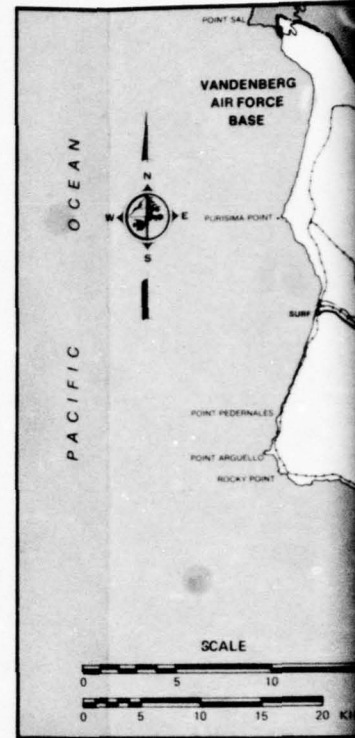
Land Use (3.3.2.1.6). Implementation of the MX project and the concurrent activity of the Space Shuttle Program and the proposed LNG terminal will indirectly result in conversion of some vacant or agricultural land to urban land uses. The anticipated increase in both direct and indirect employment opportunities in Santa Barbara County will require additional housing, commerce, and industry to meet the demands of an increased population. This section quantifies the requirements for residential, commercial, and industrial land during the peak MX construction year (1981) and during the height (1985) of the MX operations phase.

The currently scheduled peak of construction activity for the three projects (MX, Shuttle, and LNG) occurs during 1981. Thus, land use impacts have been estimated for that year to allow for a discussion of the "worst case" effects.

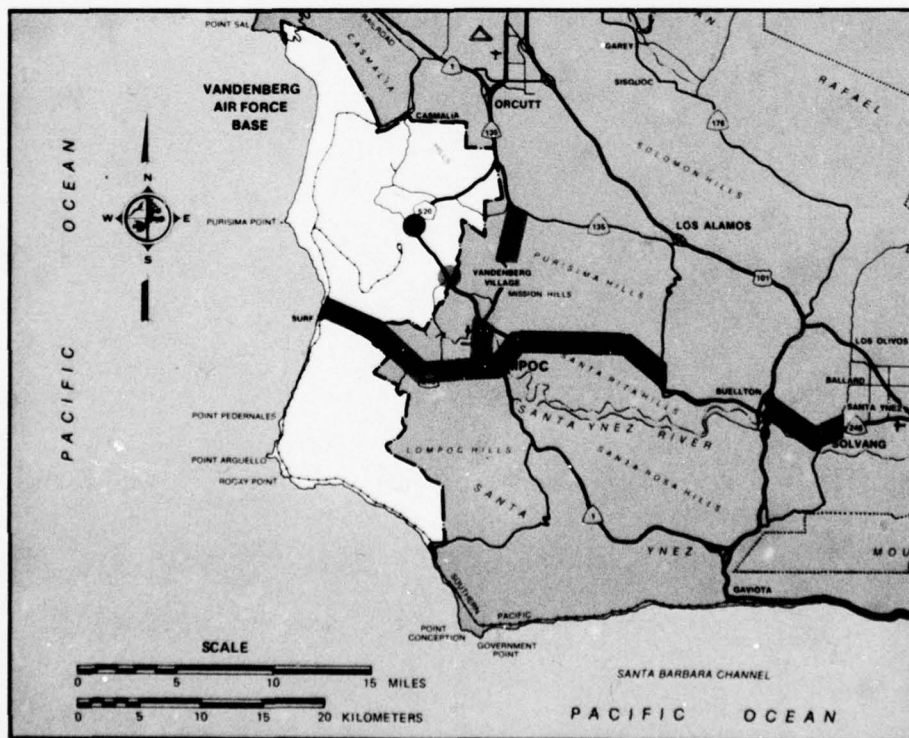
Land use acreage requirements for Santa Barbara County have been estimated and are summarized in Tables 3-37 and 3-38. The additional acreage required between 1975 and 1981 without the occurrence of any of the projects was interpolated from the 1990 requirement as determined by Livingston and Associates in the Santa Barbara County *Proposed Comprehensive Plan*.



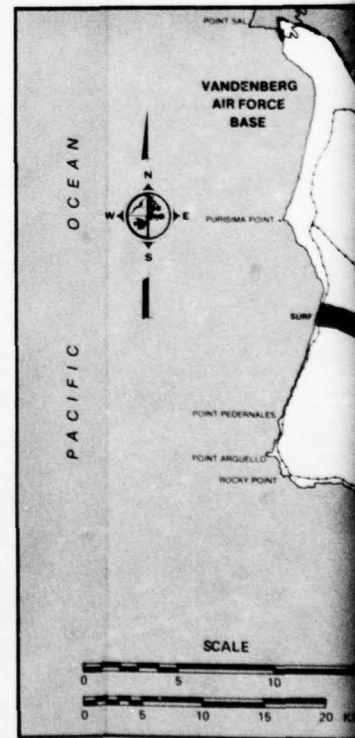
PRESENT (1977) PEAK HOUR CONGESTION.



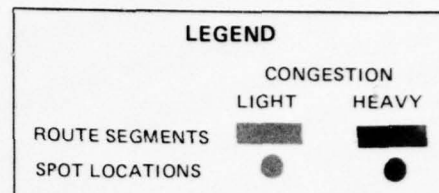
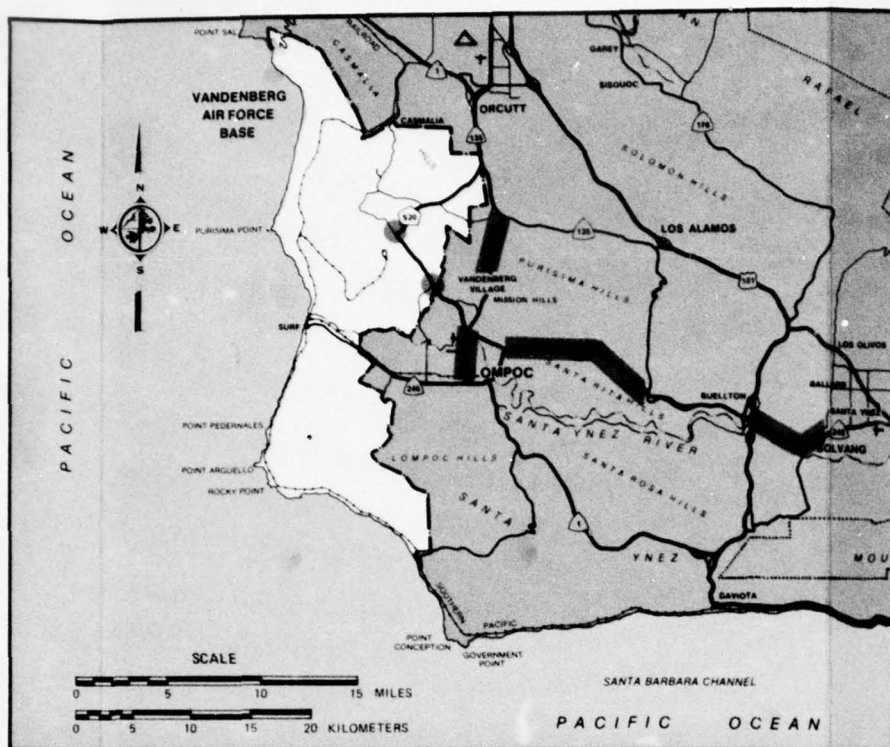
B. PROJECTED (1981) PEAK HOUR CONGESTION WITH SPACE SHUTTLE UNDER CONSTRUCTION BUT WITHOUT MX.



C. PROJECTED (1981) PEAK HOUR CONGESTION WITH SPACE SHUTTLE UNDER CONSTRUCTION BUT WITHOUT MX.

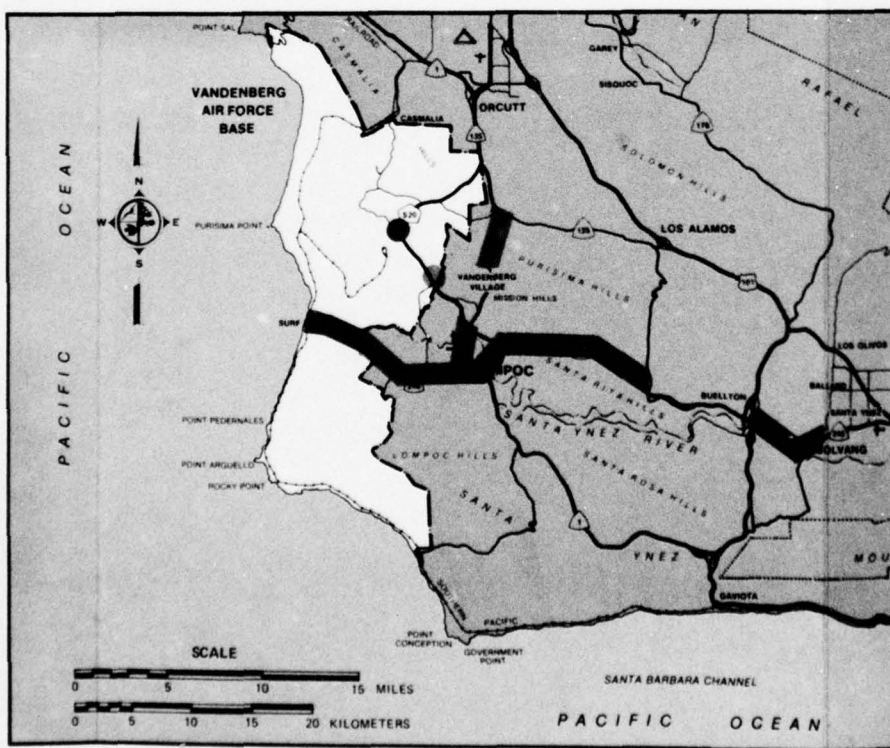


D. PROJECTED (1981) PEAK HOUR CONGESTION WITH SPACE SHUTTLE AND MX.



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B. PROJECTED (1981) PEAK HOUR CONGESTION WITHOUT SPACE SHUTTLE OR MX PROJECTS.



D. PROJECTED (1981) PEAK HOUR CONGESTION WITH SPACE SHUTTLE AND MX BOTH UNDER CONSTRUCTION.

Figure 3-13. Present and projected (1981) peak hour congestion scenarios in the Vandenberg Environment.

Missile Flight Testing III-335

Table 3-37. Residential acreage requirements for MX construction phase induced growth, 1975-1981.

LOCATION	ACRES (HA) REQUIRED			
	PROJECTED BY 1981	PROJECT-RELATED REQUIREMENTS		
		LNG	SHUTTLE	MX
Lompoc Area	160 (64)	30 (12)	130 (52)	10 (4)
Santa Maria-Orcutt Area	210 (84)	50 (20)	160 (64)	10 (4)
Santa Ynez Valley	110 (44)	10 (4)	40 (16)	— ¹
North County ²	670 (268)	110 (44)	320 (128)	20 (8)
South Coast	1,350 (540)	120 (48)	230 (92)	20 (8)
Total County	2,020 (808)	230 (92)	550 (220)	40 (16)

¹Fewer than 5 acres (2 ha).

²Includes areas outside of the three planning areas discussed.

³Based on Livingston and Associates, 1976.

Table 3-38. Commercial and industrial acreage requirements for MX construction phase induced growth 1975-1981.

LOCATION	ACRES (HA) REQUIRED			
	PROJECTED BY 1981	PROJECT-RELATED REQUIREMENTS		
		LNG	SHUTTLE	MX
Commercial				
South Coast	110 (44)	20 (8)	30 (12)	10 (4)
North County	50 (20)	10 (4)	20 (8)	— ¹
Total County	160 (64)	30 (12)	50 (20)	10 (4)
Industrial				
South Coast	60 (24)	30 (12)	50 (20)	10 (4)
North County	30 (12)	70 (28)	30 (12)	10 (4)
Total County	90 (36)	100 (40)	80 (32)	20 (8)

¹Fewer than 5 acres (2 ha).

²Based on Livingston and Associates, 1976.

As can be seen from Table 3-37, residential land use requirements of LNG and the Space Shuttle will have a large impact on the North County. In Lompoc and Santa Maria, the two projects together will absorb 48 percent of the additional land for residential use projected for the North County for 1981. On the South Coast, their requirements are one-fourth of the development that would take place through natural growth; and in the whole county, residential development induced by the three projects represents nearly 40 percent of the anticipated County growth.

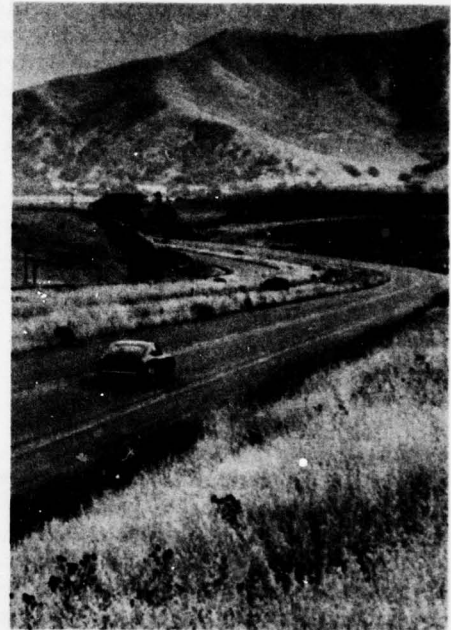
The effect of MX by itself is minimal, with the residential land required being about 2.0 percent of the total acres needed in the county by 1981. Even as a function of the total additional acres developed because of all three projects, the MX requires only about 4.9 percent of that total. By itself, MX will require the conversion of only about 40 acres (16 ha) in the entire county for residential expansion. However, when combined with LNG and Space Shuttle activities, the impact is substantial: by 1981, the three projects would account for about 30 percent of all the land required for additional housing between 1975 and 1981.

The residential acreage requirements are based on: induced population for each project, distribution of population into very low (0.65 DU/ac), low (3.5 DU/ac), medium (10 DU/ac), and high (15-20 DU/ac). Density categories and distribution into county areas according to *The Santa Barbara Proposed Comprehensive Plann* (Livingston and Associates, 1976), the residential average requirements shown in Table 3-37 do not mean that the project induced population will live in new housing, only that the inventory of housing scheme will have to be expanded by that amount by 1981 to accommodate the total population needs that year.

Few acres within the county have planned on where development should take place and the number of acres available for it. One place where such has been done, however, is the Santa Maria-Orcutt area. Here, approximately 1,080 acres (142 ha) are available for residential development, a figure that could easily accommodate the project requirements by 1981 (City of Santa Maria, Community Development Department, January 1977). If the additional development takes place in the section of the planning area set aside for it, no adverse impacts are foreseen.

In the Lompoc area, the total acres required in 1981 [330 (132 ha)] represents about 20 percent of the existing residential acreage. The Lompoc land use plan anticipates an 8,000-person increase in population in the Lompoc Valley between 1975 and 1980. The same plan assumes that of the increase can be accommodated within existing areas planned for development (City of Lompoc Community Development Department, 1974). Population projections for this report assume a 4,000-person increase between 1975 and 1981; therefore, it is likely that the required residential expansion could occur in designated areas. Most of the city is currently built on highly productive and agriculturally important soil, and this trend would likely be continued with concomitant conversion

The projection of residential location choice by new MX-related employees is made difficult by changes in transportation networks, including this new, very lightly traveled four-lane segment of Highway 246 between Buellton and Lompoc. Improved roads have reduced total travel time between VAFB and the Santa Ynez Valley by approximately one-half since the early 1960s.



of prime agricultural land to urbanized uses, one of the major land use problems of the state. The presence of existing growth controls on the South Coast should not prevent the accommodation of needed additional residential development. A total of nearly 6,300 extra housing units will be required on the South Coast by 1981 (see Section 3.1.3.3).

Table 3-38 indicates the expected land requirements for new commercial and industrial businesses by 1981. Figures are not available for each of the subareas in the North County and South Coast. The additional commercial requirements of 170 acres (68 ha) on the South Coast and 80 (32 ha) in the North County are not significant increases over existing commercial areas: there are over 500 acres (200 ha) of commercial area in the City of Santa Barbara alone and over 1,000 acres (400 ha) in the North County. By itself, MX would require only 20 acres (8 ha) while the LNG and Space Shuttle programs would require 180 (72 ha) between them. This is twice the requirement of natural growth.

The commercial and industrial acreage requirements shown in Table 3-38 are based on: the projected distribution of commercial and industrial project induced jobs between North County and South Coast, and employees per acre standards set forth by the Santa Barbara County *Proposed Comprehensive Plan* (Livingston and Associates, 1977). These standards range from 20 employees per acre for the construction industry to 175 employees per acre for some office space uses.

Industrial land requirements are more out of proportion to existing acreage than are commercial requirements. A total of 290 acres (116 ha) will be required in the County, split fairly evenly between North County and South Coast. Nearly one-third of these are the direct and indirect result of LNG construction. Of the three projects, this is the only one where the actual site is off base. Therefore, direct labor has been included in the calculations, making its requirements the largest individual portion. Due to the nature of the projects and their need for a sizable construction force (construction is classified as part of the industrial sector), the relatively high industrial acreage is understandable. Depending on the encouragement or lack of it given to industries in the future in the form of requested zone changes, tax breaks, provision for industrial parks, and the like, this acreage requirement could be met.

Operations Phase (3.3.2.2). The construction phase will be assumed to terminate at the end of the first quarter of 1983 when basing mode construction will be completed. During the period 1 April 1982 to 31 March 1983, a force estimated at 580 workers will be engaged in activation, installation and checkout of test and other support equipment in the structures completed. Beginning 1 April 1983, the testing period will be initiated where further activation will be carried out to ready all facilities and equipment and test missiles for eventual flight testing out of the basing mode chosen. Testing would be completed by the end of March 1987, so a 4-year time span is covered by these activation and testing activities.

About 580 direct MX related jobs will be provided on the system testing for each of 4 years. A cost factor of \$45,000 per job per year is reasonable for pay, benefits, burden, fees, and some consumables used on the job. On this basis, total local expenditures for testing are estimated to be \$104.4 million. Direct earnings by the work force will be about \$20,000 per job per year so total direct earnings will be \$46.4 million. Annual average direct earnings are projected to be \$11.6 million per year.

Indirect earnings should average \$10.6 million for each year of testing and this will support 863 jobs with an average income of \$12,000 per year.

Earnings (3.3.2.2.1). MX projections for the operations phase are based on an assumed constant work force of 580 jobs. Cumulative impacts involve the Space Shuttle peak in 1985 so that year has been selected for analysis. In 1985, earnings in Santa Barbara County attributable to MX will total \$21.9¹ million (including \$11.6 million

¹All values are 1977 dollars.

in direct earnings). By that year, total county earnings from all other sources (except the Shuttle) will approach \$2.4 billion. Thus, MX will increase county earnings less than 0.1 percent over baseline projections. The earnings will not be evenly distributed across the county since essentially all direct earnings will accrue to North County only. North County earnings resulting directly or indirectly from MX will equal about \$15.7 million in 1985 while earnings from other sources are projected to be about \$9.5 billion. Thus, MX will increase North County earnings less than 0.2 percent over baseline projections.

The Shuttle will increase North County earnings about \$36.4 million (over twice the MX impact) and the countywide increase should equal \$46.7 million. When added to MX impacts, total earnings¹ in the county will equal \$68.2 million and North County's share is about \$52.1 million. In relative terms, the cumulative impact of MX and the Shuttle's peak operations year is almost a 3 percent increase in earnings countywide and over a 5 percent increase in North County earnings.

Increases of this cumulative magnitude could become inflationary if they are in addition to normal growth projected for the area. However, Santa Barbara County has experienced a growth slowdown in the past several years so baseline growth projections are now believed to be overly optimistic. The cumulative effects of MX and the Shuttle may result in the county achieving, not exceeding, the baseline projections.

Employment (3.3.2.2.2). As noted, the MX testing phase will involve about 580 direct jobs. The indirect earnings discussed above will support 825 to 875 additional jobs in the county. These employment levels will be reasonably constant over the 4 years of activation and testing and will likely continue during a SAC operations phase if deployment of MX is achieved. This latter phase is not included in this analysis. Santa Barbara is projected to have 120,000 to 140,000 jobs by 1985, so MX will account, directly and indirectly, for about 1 percent of the county's total employment. Concentration of employment is greatest in North County since all direct jobs occur there. Total MX employment in North County will be about 900 to 950 jobs including the 580 direct jobs. North County employment from all other sources is projected to be 43,000 to 44,000 jobs, so MX could increase North County employment about 2 percent.

Employment related to the Shuttle will peak in 1985 at about 2,900 jobs, including almost 1,500 direct jobs. North County's share of total jobs will be about 2,000 to 2,100. Cumulatively, MX and the Shuttle

¹LNG has not been included in cumulative impacts analysis for the operations phase as these are expected to be minor. Only 90 jobs are involved in operation of the LNG facility.

will provide over 4,300 jobs in Santa Barbara County, including over 3,000 jobs in North County alone. These are not all new jobs. Particularly in the case of the Shuttle, it is believed that direct employment will be filled by transfer of responsibilities from current Vandenberg activities to new ones. Alternatively, MX does represent essentially all new jobs in the area. If Minuteman testing declines (as is possible if current plans to close Minuteman production lines are realized), MX would offset the loss of employment that would otherwise occur. There are, of course, large uncertainties involved in these alternatives.

Population (3.3.2.2.3). To estimate population effects from employment effects, the following assumptions have been used:

- All MX-related direct jobs and 50 percent of the indirect jobs will require population in-migration.
- Shuttle direct jobs will either require no in-migration or as a "worst case" in-migration of 20 percent of the direct jobs; indirect jobs will range between no importation to 30 percent of the total indirect jobs (Source: Shuttle FEIS).
- New jobs requiring in-migration are converted into population using a factor of 2.32 people per job that is appropriate for California in 1985.

MX activation and testing activities will be carried over a four-year period, 1983-1987. Shuttle operations phase starts in 1982, but operations work force peaks in 1985. Hence, 1985 is chosen as a worst case year for analysis.

In 1985 MX related direct and indirect population migrating into the project area (Santa Barbara County) will amount to 2,225-2,450 persons (Table 3-39). This will mean a population increase of 0.7-0.8 percent over the baseline projections for 1985. It should be noted that this increase will occur between 1981 and 1985, although it is shown against the representative year, 1985 (see Figure 3-12 for annual changes). Similarly, Shuttle will add 1,600-1,725 persons during this period for a cumulative total of 3,825-4,175 persons, representing a 1.2 to 1.4 percent increase over the baseline projections for 1985. The increase caused by Shuttle operations is presented as a "worst case" situation which may not occur, if all jobs are filled by transfer of responsibilities from current Vandenberg activities as planned.

Population increases related to MX in various Planning Areas of North County, where most impacts will be felt, will vary from 1.3 to 2.5 percent. Cumulative impacts of the MX and Shuttle projects will increase the Lompoc Planning Area population by 3.7 to 3.9 percent over the 1985 baseline projections (Table 3-40). It should be noted that although these data show more people in 1985 than the no projects

Table 3-39. In-migrant population distribution by planning area, 1985.¹

PLANNING AREA	MX	SHUTTLE	TOTAL
Lompoc	775-825	450-475	1,225-1,300
Santa Maria/Orcutt	750-800	500-525	1,250-1,325
Santa Ynez Valley	150-200	100-125	250-325
North County	1,675-1,825	1,050-1,125	2,725-2,950
South Coast	550-625	550-600	1,100-1,225
Santa Barbara County	2,225-2,450	1,600-1,725	3,825-4,175

¹Population distribution is derived in the following manner: All direct workers and their families and 40 percent of the indirect population will be located in the North County, leaving 60 percent of the indirect population for the South Coast (this reflects current economic activity in the County). Within North County, direct workers and their families will distribute as follows: Lompoc 50 percent; Santa Maria/Orcutt, 40 percent; Santa Ynez Valley and other areas, 10 percent. Indirect growth in the North County will be distributed as follows: Lompoc, 30 percent; Santa Maria/Orcutt, 60 percent; other areas, 10 percent.

Table 3-40. Comparative population change due to MX and cumulative effect of MX and Shuttle, 1985.

PLANNING AREA	BASELINE PROJECTIONS 1985 (without MX or Shuttle) ¹	POPULATION CHANGE, DUE TO MX	PERCENT POPULATION CHANGE, DUE TO MX	CUMULATIVE POPULATION INCREASE (MX and SHUTTLE)	PERCENT POPULATION CHANGE (CUMULATIVE)
Lompoc	33,470	775-825	2.3-2.5	1,225-1,300	3.7-3.9
Santa Maria/Orcutt	57,520	750-800	1.3-1.4	1,250-1,325	2.2-2.3
Santa Ynez Valley	11,827	150-200	1.3-1.7	250-325	2.1-2.7
North County	123,118	1,675-1,825	1.4-1.5	2,725-2,950	2.2-2.4
South Coast	185,970	550-625	0.3-0.4	1,100-1,225	0.6-0.7
Santa Barbara County	309,088	2,225-2,450	0.7-0.8	3,825-4,175	1.2-1.4

¹Baseline projections are interpolated from 1975 populations of the planning area and the 1990 projections (moderate growth scenario) of Livingston and Associates, 1976.

alternatives, they also represent declines over the 1980-81 period when construction activities peak. For example, between 1980 and 1985, there will be a net reduction of about 3,000 jobs among non-construction in-migrants from LNG/Shuttle. MX will affect about 1,000 of the potential losses (see Figure 3-12). Additionally, at least some of the 580 operative jobs on MX may be employment opportunities for these people although most are technical jobs requiring special training. Other job losses will be filled through unrelated economic growth, declines in the labor force participation rate, out-migration, and some increased unemployment.

Housing (3.3.2.2.4). The estimate of housing demand generated by MX and Shuttle operations personnel in 1985 is provided in Table 3-41. A household size of 2.6 was used to convert population increases related to direct workforce to households. For indirect workers, a factor of 2.5 was used. These factors are slightly less than those used during the construction phase to reflect the decline in household size being experienced nationwide. MX may require 900 housing units of the 11,000 new units projected by local planners under the assumptions of the moderate-growth scenario. These additional increases are well below the upper limit of locally anticipated growth (the high-growth scenario). While the increase can therefore be viewed as not significant, the impact would be great if all the increase occurred in a single year (or shorter time), particularly when Shuttle effects are also added.

Table 3-41. Housing demand generated by no project, MX, and the Shuttle, by area, in 1985.

AREA	EXISTING UNITS (1975) ¹	PROJECTED INCREASE BY 1985 ²	PROJECT-RELATED REQUIREMENTS		
			MX	SHUTTLE	TOTAL VAFB PROJECTS
Lompoc	11,565	1,275	290-330	130-180	420-510
Santa Maria-Orcutt	18,548	1,320	290-330	130-180	420-510
Santa Ynez Valley	4,548	230	60-80	20-40	80-120
North County Total	36,261	3,520	640-740	280-400	920-1,140
South Coast Total	65,667	7,840	200-250	90-140	290-390
Santa Barbara County Total	101,928	11,350	840-990	370-540	1,210-1,530

¹From State of California, Department of Finance, 1976.

²Based on Livingston and Associates, 1976.

Vacancy rates are an important indication of the tightness of the housing market. A combined vacancy rate for rental and owner-occupied units that falls below 3.75 percent indicates a serious housing shortage. (Rental units usually have a higher vacancy rate than owner-occupied.) A vacancy rate above 3.75 percent is needed to house both those people who are forming new households (this accounts for 1.25 percent to 1.75 percent of the vacancy factor), as well as those people who are in the process of moving to another dwelling or into the area.

The average vacancy rate in California for both rental and owner-occupied units is 4 percent to 5 percent, 6.5 percent for renter, and 2.5 percent for owner. In Santa Barbara County, according to the 1975 Census, the average rate is 3.6 percent. Countywide, for single-family units (usually owner-occupied), the rate is even lower (2 percent).

Effects noted above for MX and the Shuttle will substantially reduce the county's 3.6 vacancy factor. Thus, in 1985, should there be approximately 3,600 vacant housing units, the Shuttle's demand of 370 to 540 would reduce the vacancy rate by about 13 percent. The two projects combined, requiring on the order of 1,400 new units, could reduce the vacant units to about 2.2 percent. An orderly market for housing to function typically involves a 5 percent vacancy rate. Lower rates, such as 2.2 percent, create pressure on housing prices and rents, and generally lead to additional construction. Therefore, the projects would require building additional units for new jobholders and their households.

Housing needs have been estimated from the number of new direct and indirect jobholders estimated through the multiplier and information provided in the project description. Salaries will tend to reflect those currently being paid in the North County area since both on- and offbase are generally an extension of existing employment opportunities. In the housing market, they will require a mix of unit types similar to those that currently exist in Lompoc, Orcutt, and Santa Maria. Housing costs in these areas are much lower than elsewhere in Southern California (\$70,000 vs. \$100,000 for an average single-family detached purchase unit) so that much of the demand can be satisfied. Rental and condominium units will also be in demand but the areas of growth have sufficient appropriately zoned lands to meet these requirements.

Transportation (3.3.2.2.5). The additional highway traffic created by workers expected to live in the study area due to the operational phase of the MX project are believed to be insignificant in comparison to the volumes of trips generated by the present population. Peak-hour traffic generated by the labor force, however, will have some effect on the volumes of commuter traffic over various road segments.

Table 3-42 shows the anticipated places of residence of the work force which will be involved in operating the MX project.

Table 3-42. Anticipated location of residence for MX operational personnel.

LOCATION	MAXIMUM NUMBER OF WORKERS
Lompoc	290
Santa Maria/Orcutt	232
Santa Ynez Valley	58
Total	580

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The MX operational personnel trips have been assigned to logical routes of travel. Tables 3-43 and 3-44 show the anticipated 1985 peak hour increases in directional traffic, for various route segments. These tables also show the new 1985 baseline volumes expected due to normal growth and the increases which can be expected during the operational phase of the Shuttle. In preparing estimates, consideration has been given to differences in the size of the required work force and in anticipated changes in the home locations of the various personnel. In the latter case, it has been assumed that the more permanent operational workers will prefer home sites in the Lompoc and Santa Maria/Orcutt areas rather than accepting more dispersed locations which would be acceptable to construction personnel expecting to stay in the area for only a limited time.

Comparison of the estimated 1985 traffic volumes during the operational phase of the MX (and Shuttle) facility with those anticipated during the construction phase, previously presented on Tables 3-18 and 3-19, discloses anticipated decreases in traffic on some road segments.

Figures 3-14A and B show the locations of present and anticipated 1985 congestion assuming neither the Shuttle or MX are constructed. It is estimated that the degree of congestion, due to normal traffic growth, will increase from light to heavy on Route 246 east of Buellton and on the two lane section between Buellton and Lompoc. Normal growth also is expected to adversely affect the intersection adjacent to the Main Gate.

Table 3-43. Increased traffic (peak hour volumes) in 1985 due to Shuttle and M

ROUTE SEGMENT	1985 BASELINE VOLUME	INCREASE DUE TO SHUTTLE OPERATIONS	INCREASE DUE TO MX OPERATIONS			TOTAL VOLUMES WITH SHUTTLE AND MX OPERATIONS			ROADWAY CAPACITY	LOMPOC TERRACE SITE
			LOMPOC TERRACE SITE	BURTON MESA SITE	EITHER OF TWO NORTHERN SITES	LOMPOC TERRACE SITE	BURTON MESA SITE	EITHER OF TWO NORTHERN SITES		
ONE DIRECTION VOLUMES										
Route 101 South of Gaviota Pass	1,730	-	-	-	-	1,730	1,730	1,730	2,310	-
Route 101 South of Buellton	1,520	-	-	-	-	1,520	1,520	1,520	2,310	-
Route 101 South of Los Alamos	1,785	2	-	6	23	1,787	1,793	1,810	2,340	-
Route 1 West of East Junction with Route 246	485	15	58	-	-	558	500	500	1,420	-
Route 1 at Santa Ynez River (Lompoc)	1,537	43	-	145	145	1,580	1,725	1,725	2,000	-
Route 1 North of Vandenberg Road (S20)	1,440	113	232	232	186	1,785	1,785	1,739	1,790	-
Route 246 West of Route 1 (Lompoc)	1,050	52	58	-	-	1,160	1,102	1,102	1,180	-
Route S20 Northwest of Route 1	1,302	50	-	197	180	1,352	1,549	1,532	1,900	-
Route S20 Southeast of Main Gate	619	22	-	139	238	641	780	879	1,900	-
Route S20 Northeast of Main Gate	923	109	232	238	-	1,264	1,270	1,276	1,900	-
Route S20 Southwest of Route 1	930	107	232	232	186	1,269	1,269	1,223	1,900	-
Route 135 North of Route 1	1,001	113	232	232	186	1,346	1,346	1,300	2,240	-

Table 3-44. Increased traffic (peak hour volumes) in 1985 due to Shuttle

ROUTE SEGMENTS	1985 BASELINE VOLUME	INCREASE DUE TO SHUTTLE OPERATIONS	INCREASE DUE TO MX OPERATIONS			TOTAL VOLUMES WITH SHUTTLE AND MX OPERATIONS			ESTIMATED T WITH SHUTTLE	
			LOMPOC TERRACE SITE	BURTON MESA SITE	EITHER OF TWO NORTHERN SITES	LOMPOC TERRACE SITE	BURTON MESA SITE	EITHER OF TWO NORTHERN SITES	LOMPOC TERRACE SITE	BURTON MESA SITE
			TWO DIRECTION VOL							
Route 1 South of Lompoc	218	-	-	-	-	218	218	218	363	
Route 1 North of Mission Hills	260	6	-	-	-	266	266	266	433	
Route 1 Northwest of Orcutt	141	-	-	-	-	141	141	141	235	
Route 246 East of Buellton	895	-	-	-	-	895	895	895	1,491	1,491
Route 246 West of Buellton	660	28	58	52	35	746	740	723	1,186	1,186
Route 246 West of Lompoc- Casmalia Road	204	15	58	-	-	277	219	219	413	
Route 246 West of Lompoc	436	110	290	58	29	836	604	575	1,426	
Route 135 West of Los Alamos	47	2	-	6	23	49	55	72	80	
Lompoc-Casmalia Road Northwest of Main Gate	225	-	-	-	238	225	225	463	375	
Lompoc-Casmalia Road South of Casmalia	130	6	-	-	46	136	136	182	223	
Lompoc-Casmalia Road Northwest of Route 246 (Lompoc)	195	13	-	52	35	208	260	243	338	
San Antonio Road East of Route S20	20	2	-	6	23	22	28	45	35	

due to Shuttle and MX operational workers (four lane roads).

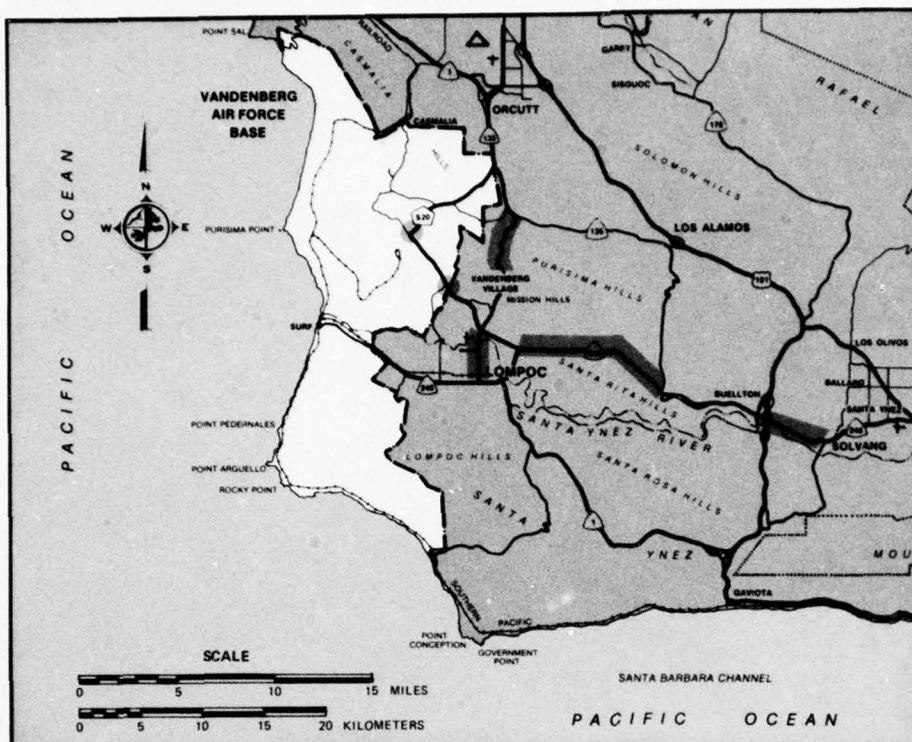
SITH ATIONS	ROADWAY CAPACITY	EXCESS OVER CAPACITY			DEGREE OF CONGESTION					
		LOMPOC TERRACE SITE	BURTON MESA SITE	EITHER OF TWO NORTHERN SITES	LOMPOC TERRACE SITE		BURTON MESA SITE		EITHER OF TWO NORTHERN SITES	
					LIGHT	HEAVY	LIGHT	HEAVY	LIGHT	HEAVY
ONE DIRECTION VOLUMES										
1,730	2,310	-	-	-						
1,520	2,310	-	-	-						
1,810	2,340	-	-	-						
500	1,420	-	-	-						
1,725	2,000	-	-	-			✓		✓	
1,739	1,790	-	-	-						
1,102	1,180	-	-	-						
1,532	1,900	-	-	-						
879	1,900	-	-	-						
1,276	1,900	-	-	-						
1,223	1,900	-	-	-						
1,300	2,240	-	-	-						

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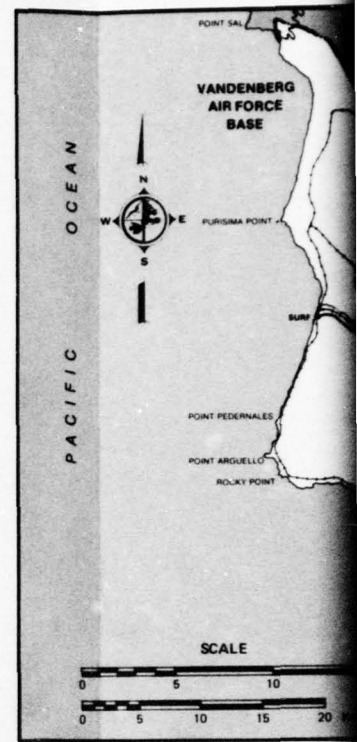
in 1985 due to Shuttle and MX operational workers (two lane roads).

VOLUMES WITH MX OPERATIONS		ESTIMATED TWO DIRECTION VOLUMES WITH SHUTTLE AND MX OPERATIONS			ROADWAY CAPACITY	EXCESS OVER CAPACITY			DEGREE OF TRAFFIC CONGESTION					
ION IA RE	EITHER OF TWO NORTHERN SITES	LOMPOC TERRACE SITE	BURTON MESA SITE	EITHER OF TWO NORTHERN SITES		LOMPOC TERRACE SITE	BURTON MESA SITE	EITHER OF TWO NORTHERN SITES	LOMPOC TERRACE SITE		BURTON MESA SITE		EITHER OF TWO NORTHERN SITES	
									LIGHT	HEAVY	LIGHT	HEAVY	LIGHT	HEAVY
TWO DIRECTION VOLUMES														
18	218	363	363	363	800	-	-	-						
46	266	433	433	433	320	113	113	113	✓		✓			✓
11	141	235	235	235	850	-	-	-						
95	895	1,491	1,491	1,491	1,150	341	341	341		✓		✓		✓
40	723	1,186	1,180	1,163	900	286	280	263		✓		✓		✓
19	219	413	355	355	750	-	-	-						
94	575	1,126	894	865	800	326	94	65		✓				
55	72	80	86	103	800	-	-	-						
75	463	375	375	615	700	-	-	-						
96	182	223	223	269	650	-	-	-						
50	243	338	390	373	600	-	-	-						
18	45	35	41	58	400	-	-	-						

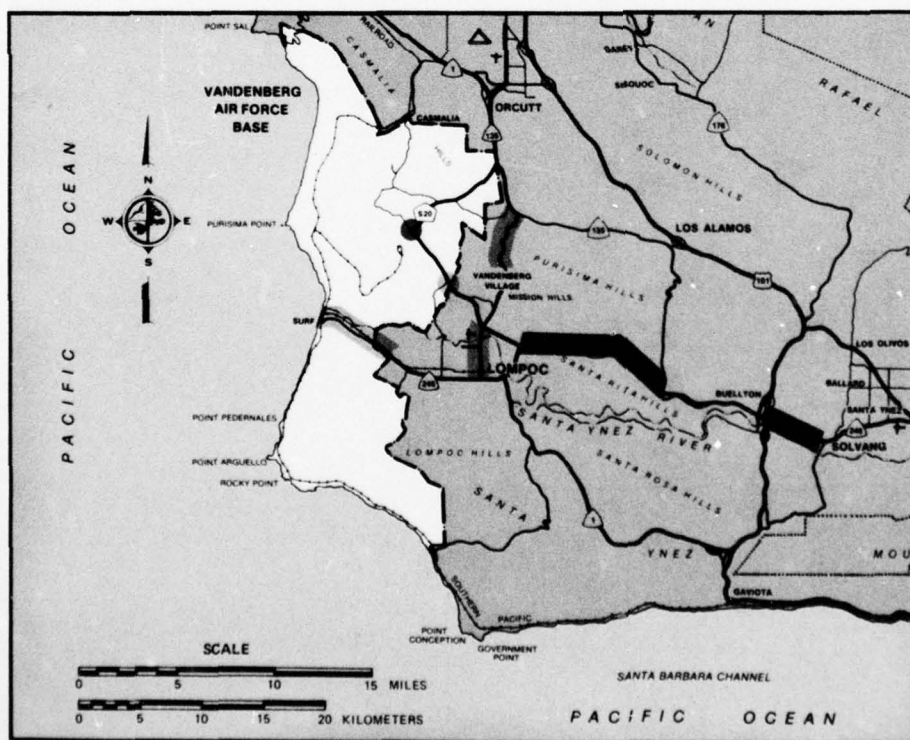
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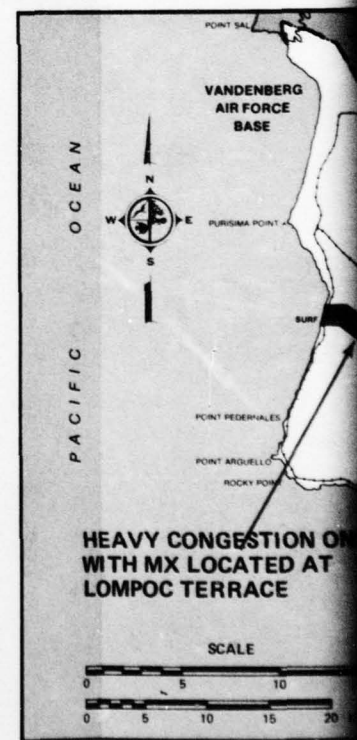
A. PRESENT (1977) PEAK HOUR CONGESTION.



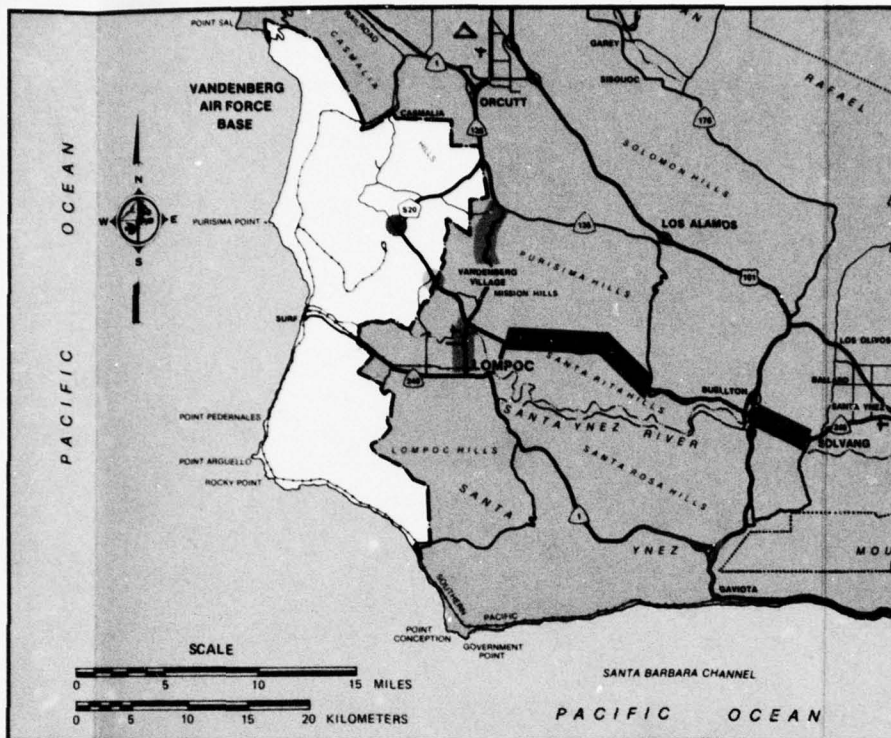
B. PROJECTED (1985) PEAK HOUR CONGESTION.



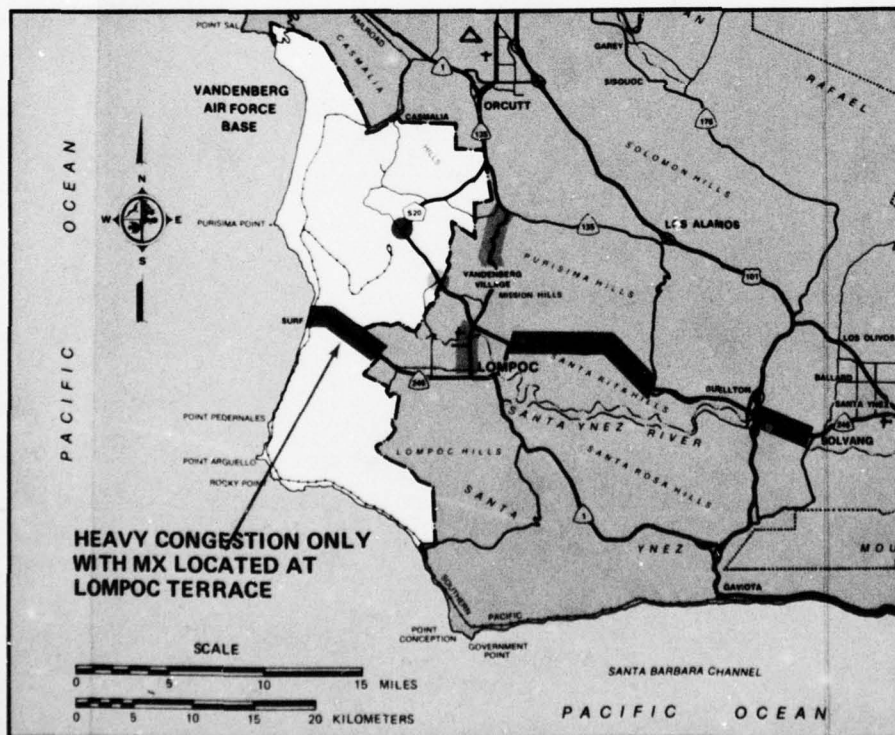
C. PROJECTED (1985) PEAK HOUR CONGESTION WITH SPACE SHUTTLE IN OPERATION BUT WITHOUT MX.



D. PROJECTED (1985) PEAK HOUR CONGESTION WITH SPACE SHUTTLE IN OPERATION AND MX.



B. PROJECTED (1985) PEAK HOUR CONGESTION WITHOUT SPACE SHUTTLE OR MX PROJECTS.



D. PROJECTED (1985) PEAK HOUR CONGESTION WITH SPACE SHUTTLE AND MX IN OPERATION.

Figure 3-14 Present and projected (1985) peak hour congestion scenarios in the Vandenberg Environment.

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Figure 3-14C shows anticipated 1985 congestion assuming both the MX Shuttle, but not MX, is operational in 1985. As comparison with Figure 3-14B indicates, it is estimated that the only change in congestion will occur along Route 246 west of Lompoc where light congestion could be expected due to the Shuttle operational workers.

Figure 3-14D shows anticipated 1985 congestion assuming both the MX and the Shuttle are in operation. As illustrated, the construction of the MX at the Lompoc Terrace CSA would change the congestion condition on Route 246 west of Lompoc from light to heavy.

Peak hour congestion now occurs on H Street (Route 1) in the City of Lompoc. As was shown in Table 3-43, construction of the MX facility at any of the three most northern proposed sites might add approximately 145 vehicles to the H Street peak hour flows. Although this volume is relatively small, it will tend to create a slight increase in traffic congestion.

An analysis of projected traffic (including increases due to indirect growth) along H Street (Lompoc's major north-south street) during a "worst case" scenario of both MX and Space Shuttle in operation during 1985 and selection of one of the candidate siting areas on North Vandenberg found moderate congestion occurring only at the North Avenue intersection. This congestion would correspond to Level of Service "D"—described in the Highway Capacity Manual #25 as "Delays to approaching vehicles may be substantial during short peaks within the peak period, but enough cycles with lower demand would occur to permit periodic clearance of developing queues, thus preventing excessive backups". All other locations were found to operate without congestion. Measures to reduce congestion at North Avenue were evaluated such as revising the existing land configuration on the westbound approach (by restriping the intersection within the existing 40 ft wide paved area) from one approach lane and one exit lane to two approach lanes and one exit lane. The resulting change would reduce the number of conflicting movements within the intersection enough to provide for Level of Service "C" in the 1985—Both Projects scenario. (Level of Service "C", "Occasionally drivers may have to wait through more than one red signal indication and back-ups may develop behind turning vehicles. Most drivers feel somewhat restricted, but not objectionally so...this is the level typically associated with urban design practice.")

Since North Avenue was the location of the most significant impact, and a relatively minor adjustment to the configuration of that intersection reduced the MX/Shuttle traffic impact to satisfactory levels, it was concluded that heavy traffic impact on "H" Street in Lompoc would not result from the 1985 Both Projects scenario.

If the Lompoc Terrace site is selected, traffic can be expected to increase on Route 246 through Lompoc. Severe congestion is not anticipated

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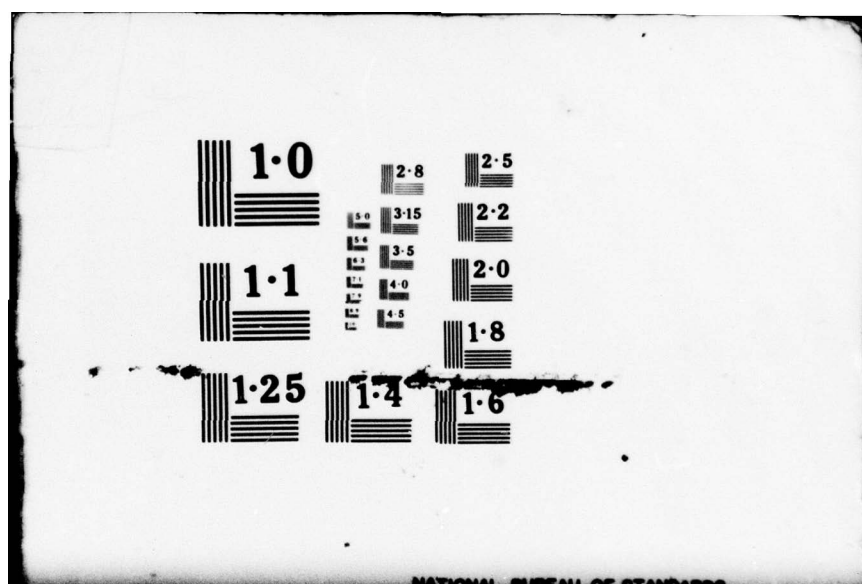
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because of the MX operational workers; however, since the total increase on Route 246 due to them would only total approximately one vehicle per minute.

Construction of the MX facility at either the Shuman Canyon or the San Antonio sites would result in some additional traffic on Black Road north of the Titan Gate (a relatively hazardous section of highway). The anticipated volumes of new traffic expected on this road segment, however, are only approximately 50 vehicles per day.

Planned Highway Improvements. The Regional Transportation Plan for Santa Barbara County has identified the following road improvements near Vandenberg as part of their 20-year forecasts:

Santa Maria-Orcutt:

- expansion of Broadway to six lanes between Donovan and Santa Maria Way
- extension of Miller Street south to Santa Maria Way
- expansion of Highway 166 to four lanes west of Santa Maria

Lompoc-Vandenberg:

- construction of a realigned two-lane section over Harris grade
- extension of Constellation Boulevard

These projects naturally would help to alleviate any potential congestion due to increased activities at Vandenberg, but the present lack of highway funds makes construction schedules uncertain. Their construction is not assumed in this analysis.

Movement of Missile Components. Missile components and support equipment could be manufactured in a number of places and the final selection of contractors has yet to be made. Until this decision is reached, transportation impacts which would occur due to the movement of missile components and support equipment from the manufacturer to Vandenberg cannot be assessed. If vehicular transport is used, U.S. Highway 101 will be used to some extent since it is the major highway with connections to the general base area.

Delivery of some component material will probably be via railroad. The tracks used will include the Southern Pacific lines in Southern California and the Vandenberg spur near the site. With two passenger trains and ten freight trains per day on the Southern Pacific line, the additional use would have minimal impact.

Launch Safety. No missile overflights of trains will occur. The Air Force presently delays its launches when conflicts with train schedules occur.

Launches are over water and, therefore, might pass over ships in the area. Danger zones have been designated in the ocean where potentially dangerous debris may fall, and marine traffic is notified of these areas by a variety of means (see Section 1.2.2.3.4). These safety procedures will continue during MX tests, and the possibility of injury or damage to marine traffic is very slight. Large shipping increases in Santa Barbara Channel, unrelated to MX, are possible in the future for oil and LNG facilities, however, so the potential impact cannot be established until basic parameters become available.

The airports that may be affected by the operations of the MX Flight Test Program are Santa Maria, Lompoc, Santa Ynez, Santa Barbara, and Los Angeles. Present plans call for about 20 flight tests during the first four years of operation plus an undetermined number of flights per year throughout the life of the system. All launch azimuths are over water, and southerly launches cross aircraft control zones 1176, 1316, and 1177, from Los Angeles to Hawaii. During launches, therefore, commercial aircraft to and from Hawaii will have to be diverted inland and north to control zone 1155 before proceeding westerly. Air traffic controllers at Los Angeles International Airport would have the responsibility for coordinating these diversion tactics. This is an established procedure for current launches. With a frequency of only four to five launches per year, coordination between air traffic controllers and base safety personnel should not present any problems.

During launch times, additional officials and visitors may use the Santa Barbara and Santa Maria airports. Increased air traffic due to VIPs and supervisory personnel are expected to be minor, as are increases due to indirect population growth. No new airport facilities will be required outside of Vandenberg. Some slight additional fuel costs may be experienced by diverted commercial aircraft.

Land Use (3.3.2.2.6). During the MX operations phase (1983-1987), the anticipated peak of activity for the MX and Space Shuttle combined occurs during 1985. Thus, land use impacts have been estimated for the year to allow for a discussion of the "worst case" effects. Onbase impacts and offbase impacts are addressed separately.

Additional residential, commercial, and industrial land use increase requirements for Santa Barbara County by 1985 have been estimated and are summarized in this section. The additional acreage required between 1975 and 1985 without the occurrence of any of the projects was interpolated from the 1990 requirement as determined by Livingstone Associates in the Santa Barbara County *Proposed Comprehensive Plan*.



Lompoc Airport. The Lompoc Airport bases private and industrial aircraft but does not currently have commercial operations. No MX flight test-related operations are expected to impact either private or commercial air operations.

Space Shuttle and MX together will require over 21 percent of the total additional "without project" requirements by 1985. In Lompoc, the two projects together will be equal to over 40 percent of the "without project" acreage requirements by 1985. On the South Coast, an estimated 4 percent of the development that would take place in natural growth would be added to the South Coast. Residential development induced by the two projects constitutes just under 10 percent of the land that would be converted to residential areas without them (see Table 3-45).

The effect of MX even without the Shuttle project is significant, especially with the residential land in the North County where MX residential acreage requirements are equal to over 14 percent of the "without project" scenario. The MX requirements represent about 7 percent of the total additional acres developed because of both projects and the "without project" element. By itself, MX will require the conversion of an estimated 230 acres (92 ha) in the county for residential expansion by 1985.

The additional 100 acres (40 ha) required by both the Space Shuttle and MX in the Santa Maria Area by 1985 represents 16 percent of the total area planned for residential development.

Table 3-45. Residential acreage requirements for MX operations phase induced growth 1975-1985.

LOCATION	ADDITIONAL ACRES (HA) REQUIRED		
	PROJECTED BY 1985 ¹	PROJECT-RELATED REQUIREMENTS	
		SHUTTLE	MX
Lompoc Area	270 (108)	40 (16)	70 (28)
Santa Maria-Orcutt Area	640 (256)	30 (12)	70 (28)
Santa Ynez Valley	180 (72)	10 (4)	20 (8)
North County	1,120 (448)	80 (32)	160 (64)
South Coast	2,250 (900)	20 (8)	70 (28)
Total County	3,370 (1,348)	100 (40)	230 (92)

¹Based on Livingston and Associates, 1976.

The Space Shuttle and MX projects with direct employment and secondary induced employment will result in a demand for approximately 110 residential acres (49 ha) by 1985. At present, approximately 60 percent of Lompoc's residents are directly or indirectly supported by Vandenberg. Assuming the ratio to hold through 1985 and assuming the Space Shuttle and MX to be the two base-related stimulants to growth, Lompoc will have a surplus of 85 acres (34 ha) of residential area over that planned by 1985 to absorb additional unanticipated growth in other industries, in other base related activities, or as a result of continued spill-over growth from the Santa Barbara-Goleta area.

In the North County, the combination of MX and the Space Shuttle will require approximately 22 percent of the additional residential acres anticipated by 1985. Along the South Coast, MX and the Space Shuttle combined will absorb an estimated 4 percent of the projected additional residential land required by 1985.

The acreage requirements shown in Table 3-45 for residential uses include both direct and indirect population housing requirements. The geographical distribution of the direct population is, Lompoc 50 percent, Santa Maria 40 percent, and Santa Ynez Valley 10 percent. This is similar to the present distribution of offbase personnel. The geographic distribution of the indirect population is, Lompoc 30 percent, Santa Maria 60 percent, and Santa Ynez Valley 10 percent. This is similar to the present population distribution in the North County area.

The operations phase residential acreage requirements shown in Table 3-45 are not in addition to the construction phase requirements shown in Table 3-37. Each stands alone and construction phase housing would become available to the operations phase population, and would help fulfill their acreage requirements. The county total residential acreage requirements of natural growth, Shuttle, and MX for the construction phase in 1981 will be about 2,610 acres (see Table 3-37), while the same requirements for the operations phase in 1985 will be 3,700 acres (see Table 3-45). The 1,090 acre difference is what will have to be developed for the three stimuli between 1981 and 1985. LNG acreage requirements are not included because the operations phase labor requirements are so small.

Table 3-46 indicates the expected land requirements for new commercial and industrial businesses by 1985. Figures are not available for each of the subareas in the North County and on the South Coast. The additional commercial areas of 210 acres (84 ha) on the South Coast and 90 (36 ha) in the North County for both projects plus natural growth represents requirements that are not significant increases of existing commercial areas: there are over 500 acres (200 ha) of commercial area in the City of Santa Barbara alone and over 1,000 acres (400 ha) in the North County. By itself, MX would require only 10 acres in the entire county and the Shuttle project would add only 20 (8 ha) more. Natural growth, however, would require an additional 270 acres (108 ha) in the county of 1985.

Industrial land requirements are more out of proportion to existing acreage than are commercial requirements. A total of 300 acres (120 ha) will be required in the county, with only about 30 percent going to the South Coast. Natural growth on the South Coast accounts for most of the disparity. Due to the nature of the projects and their need for a sizable construction force (construction is classified as part of the industrial sector) the relatively high industrial acreage is understandable. Depending on the encouragement or lack of it given to industries in the future in the form of requested zone changes, tax breaks, provision for industrial parks and the like, this acreage requirement could be met.

It will be noted that Table 3-38 projects a total of 190 acres of commercial and industrial induced by natural growth and the Shuttle and MX construction projects in 1981, while Table 3-46 indicates the same number of acres required by the same three stimuli during the operations phase in 1985. These two 190-acre requirements are not cumulative, but simply set forth the additional acreage requirements in 1981 and in 1985 above 1975 which are induced by those three forces.

The kinds of commercial and industrial employment that may be expected will follow current trends with the following exceptions: 1) government employment ratios will be slightly lower (typically government move in the opposite direction of private employment), 2) construction industry employment may be as high as 5 to 6 percent of the total labor market (much more than that found during normal periods in this area), and 3) no agricultural labor and very little mining industry labor will be induced by the Shuttle or MX projects.

Table 3-46. Commercial and industrial acreage requirements for MX operations phase induced growth, 1975-1985.

LOCATION	ADDITIONAL ACRES (HA) REQUIRED		
	PROJECTED BY 1985 ²	PROJECT-RELATED REQUIREMENTS	
		SHUTTLE	MX
Commercial			
South Coast	190 (76)	10 (4)	10 (4)
North County	80 (32)	10 (4)	— ¹
Total County	270 (108)	20 (8)	10 (4)
Industrial			
South Coast	100 (40)	20 (8)	10 (4)
North County	40 (16)	10 (4)	10 (4)
Total County	140 (56)	30 (12)	20 (8)

¹Fewer than 5 acres (2 ha).

²Based on Livingston and Associates, 1976.

Physical Impacts of the Project (3.3.3)

Construction Phase (3.3.3.1)

Air Quality (3.3.3.1.1). During construction of the MX testing facility, air quality will be affected in two primary ways: (1) by mobile emissions from the internal combustion of fossil fuels in vehicles and heavy construction equipment; and (2) by fugitive dust created by construction activities. The soil type and the proximity of the site and vehicle access routes to populated areas must also be investigated to determine the air quality impact. Upon completion of the construction activity, pollutants will disperse rapidly, and have no permanent or long-term effect on local air quality.

Mobile Emissions Associated with Construction. In order to approximate the mobile emissions resulting from the construction of the MX facility, a series of assumptions were made, based on preliminary information on the amount of material to be handled in excavating a trench and

constructing a support facility. For the trench mode, two 2-mi (3.2-km) concrete lengths of trench 20 ft deep by 20 ft wide (6.1 x 6.1 km) were assumed. The amount of concrete to construct a trench of these dimensions, plus surface pads, ramps, and buildings was estimated. A total land area of 150 acres (60 ha) was assumed to be disturbed in some fashion (trench, access roads, building foundations, pads, etc.) at any one of the three candidate sites. (The Shuman Canyon site was not considered for the trench mode.) For the shelter mode, the site acreage was assumed to be 25 acres (10 ha). These assumptions permitted estimates to be made concerning traffic levels, vehicle emissions, and dust generation. The estimates should be considered tentative until more firmly established parameters are available.

Removal of existing hardware and the construction of a surface or subsurface launch facility entails the use of heavy construction equipment, trucks, and assorted light duty vehicles. The trucks are categorized separately from the construction equipment as they are assumed here to be used only in hauling material to the construction site, i.e., they are primarily over-the-road vehicles. Estimated mobile emissions from the gasoline or diesel engines used in construction activities are shown in Table 3-47. The estimates of vehicle miles traveled (VMT) are based on average vehicle capacity, expected total material to be moved, and an average distance traveled on base. Emission factors were taken from EPA publication AP-42.

The amount of material to be hauled to the site for the in-line hybrid trench configuration is about 21,000 yd³ (16,000 m³) of concrete and 500 tons (450 metric tons) of steel for 10 aimpoints [vs. 2,100 yd³ (1,600 m³) and 80 tons (73 metric tons) respectively, for three shelters].

The potential impact of these internal combustion related emissions is small in relation to the total stationary and mobile emissions for both northern Santa Barbara County and Vandenberg. As shown in Table 3-44 the percentage increases in air pollutants at Vandenberg range from a high of 20.4 percent for carbon monoxide from trench construction to a low of 3.4 percent for hydrocarbons from shelter construction. When these emissions are compared to the total northern Santa Barbara County emissions, the increases are negligible.

In terms of ambient pollutant concentrations, the only detectable increases will occur within the immediate work area or immediately adjacent to the site access road. The largest increase will be in nitrogen oxides (NO_x). A large portion (65 to 68 percent) of the NO_x emissions is from heavy equipment (Table 3-48) and will occur in the facility construction area where there are essentially no emissions at present. An estimate of NO_x and CO concentrations from heavy equipment emissions for a 2,000 ft (610 m) trench segment with 20 pieces of heavy equipment operating was made using the California line source model. The results of these calculations along with values for light duty vehicles and heavy delivery trucks are shown in Table 3-49.

Table 3-47. Estimated mobile emissions¹ in tons/year
(metric tons/year).

FUNCTION	VM ² (km)	HC	NO _x	SO ₂	CO	PARTICULATES
Site Preparation and Excavation						
Trench	—	8.8 (8.0)	21.6 (19.6)	1.6 (1.5)	42.4 (38.5)	1.6 (1.5)
Shelter	—	6.6 (6.0)	16.2 (14.7)	1.2 (1.1)	31.8 (28.8)	1.2 (1.1)
Material Delivery						
Trench	94,000 (150,400)	1.4 (1.3)	1.29 (1.17)	0.04 (0.037)	19.44 (17.6)	0.093 (0.084)
Shelter	5,340 (8,544)	0.08 (0.07)	0.073 (0.066)	0.002 (0.002)	1.1 (0.99)	0.005 (0.004)
Operation of Light-Duty Trucks and Automobiles						
Trench	2,096,000 (3,353,600)	9.45 (8.6)	8.53 (7.74)	0.461 (0.418)	126.8 (115.0)	0.692 (0.628)
Shelter	2,096,000 (3,353,600)	9.45 (8.6)	8.53 (7.74)	0.461 (0.418)	126.8 (115.0)	0.692 (0.628)
Haul Concrete						
Trench	8,500 (13,600)	0.043 (0.039)	0.195 (0.177)	0.026 (0.024)	0.268 (0.243)	0.012 (0.011)
Shelter	480 (700)	0.002 (0.002)	0.011 (0.010)	0.002 (0.002)	0.015 (0.014)	0.0007 (0.0006)
Buildings	420 (670)	0.002 (0.002)	0.010 (0.009)	0.001 (0.001)	0.013 (0.012)	0.0006 (0.0005)
Total Estimated Construction Emissions						
Trench	2,198,920 (3,518,270)	19.71 (17.9)	31.63 (28.7)	2.13 (1.9)	188.93 (171.4)	2.40 (2.18)
Shelter	2,102,240 (3,363,580)	16.13 (14.6)	24.82 (22.5)	1.67 (1.5)	159.74 (144.9)	1.90 (1.72)

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¹Assumptions: Heavy equipment: 160 operating hours per day; shelter system constructed in 180 days; trench system constructed in 240 days; delivery vehicles travel 30 mi (48 km) on the base at 20 mph (32 kmh); workers transportation averages 200 cars to and from the site each day; concrete batch plant is 2.5 mi (4 km) from work site; heavy construction equipment is diesel powered.

²Vehicle miles traveled during construction.

Table 3-48. Percentage increase of total emissions within Vandenberg and northern Santa Barbara County due to construction of testing facilities.

EMISSION SOURCE LOCATIONS	PERCENTAGE INCREASE OF TOTAL EMISSIONS				
	HC	NO _x	SO ₂	CO	PARTICULATES
Vandenberg					
Trench	4.1	9.7	11.4	20.4	8.6
Shelter	3.4	7.6	8.9	17.2	6.8
Northern Santa Barbara County					
Trench	0.2	0.2	0.0	0.3	0.1
Shelter	0.1	0.2	0.0	0.2	0.1

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¹Percentage obtained by dividing the projected emissions for trench and shelter construction by the total estimated emissions for Vandenberg and northern Santa Barbara County and multiplying the result by 100.

Table 3-49. Source region and ambient concentrations of NO_x and CO estimated for a 3 m/sec wind and a nominal construction activity.

POLLUTANT	EMISSIONS SOURCE	SOURCE CONCENTRATION	AMBIENT CONCENTRATION ³
NO _x ¹	Light Duty Vehicles	25.2 µg/m ³	8.6 µg/m ³
	Heavy Duty Vehicles	157.2 µg/m ³	53.5 µg/m ³
	Material Delivery	3.4 µg/m ³	1.2 µg/m ³
CO ²	Light Duty Vehicles	374.0 µg/m ³	127.0 µg/m ³
	Heavy Duty Vehicles	309.3 µg/m ³	104.9 µg/m ³
	Material Delivery	51.1 µg/m ³	17.3 µg/m ³

¹California ARB standard for NO_x for one hour is 470 µg/m³.

²NAAQS for CO for one hour is 46,000 µg/m³.

³10 m from source with 3 m/sec winds.

Most vehicle NO_x is emitted as NO, which is subsequently converted to NO_2 . NO_2 concentrations reach 157 $\mu\text{g}/\text{m}^3$ at the source vehicle during heavy equipment operations. Ambient levels are much lower as shown in the table. The peak source concentration is of short duration, involves a very small area, and is rapidly diluted by local winds. Dispersion calculations using the California line source model were also made for the equipment with the largest emissions of NO_x that would be expected during construction. The limit of detectable concentrations was estimated to be less than 300 ft (90 m) from the working line source location. The model tends to produce conservative results as applied here and the actual concentrations would be quite probably lower than indicated.

Fugitive Dust. Fugitive dust is caused by two basic physical processes: (1) abrasion and pulverization of surface materials, and (2) entrainment of dust particles by turbulent air action or by wind erosion of an exposed surface.

Dust generated by excavating soil for the facility is expected to be moderate in amount. The average EPA emission factor for general construction activity is 1.2 tons of dust per acre (0.44 metric tons/ha) per month of activity. The potential dust generation rate for a 55-acre (22-ha) site (shelter mode) at Vandenberg is 66 tons (60 metric tons) per month on this basis. Dust amounts, if controlled by appropriate measures, e.g., coating of road surfaces, limiting vehicle speeds, etc., could be reduced to about half the above figures. The fugitive dust potential at any of the four candidate sites is a function of the physical soil composition and its overall moisture content. Soil composition is generally similar at all candidate siting areas and soil moisture is low.

Wind erosion of the disturbed soil is not considered to be a significant problem, since the area being disturbed at any one time will be small. Using the equation for wind erosion of soil development by the U.S. Department of Agriculture, an estimate of the amount of dust from a representative acre can be made. The potential for wind erosion of the disturbed site area is approximately 0.1 tons per acre (0.4 metric tons/ha) per year at each of the four CSAs. These dust values become inconsequential when compared to the 1.2 tons per acre (0.44 metric tons/ha) per month generated by the direct construction activity.

Precipitation Modification. The MX-related construction activity is not expected to increase the emissions levels of fine particulates to the point where inadvertent weather modifications in the form of precipitation enhancement or suppression would occur at Vandenberg or in the vicinity. With an average particle emission level of 0.3 grams per mile (0.5 g/km) per vehicle as shown in AP-42 (EPA, 1976), the maximum

contribution from the construction activity would be less than 7 lbs (3 kg) of particulates per day. The presence of large numbers of other natural nucleating agents such as salt spray from the ocean surface and fine suspended dust from agriculture make these vehicle exhaust contributions of little importance to precipitation modification.

Airborne dust generated by construction activities is not expected to affect precipitation occurrences in the surrounding area. The larger particle sizes of dust will not be airborne for long periods of time and most of it will be redeposited on the surface relatively close to the generation site. The small fraction that remains airborne, about 2.5 percent on the average (Jutze and Axetell, 1975) is not enough to provide a significant amount of additional nucleation capability.

Visibility. Visibility through the atmosphere is affected by the particulates, including particles of dust, suspended in it. The size distribution of these suspended particles can be assumed generally to cover the range from 0.02 microns up to 5.0 microns (Charlson, 1969). The small contribution to this size range of suspended particles from dust kicked up by vehicles and construction activity, has previously been pointed out. The short time that the largest particles (>50 microns) are airborne, minutes as compared to hours or days for micron and submicron-sized particles (Willeke and Whitby, 1975), means that visible dust clouds from the construction sites will dissipate rapidly, depositing most of their material close to the generation point. The remaining small fraction of material is in the size range which affects visibility through light scattering.

The exact deposition areas and locations to which suspended dust are carried will depend on the wind speeds and direction over the site. At Vandenberg, the prevailing onshore winds will tend to carry dust from the MX sites inland toward the more populated areas. The dust transport effect is expected to have little measurable impact beyond the confines at Vandenberg. On base some visible deposition on vegetation might be expected within a few hundred yards of the construction zones. Whether this would be detectable over and above the normally present dust on the plants is conjectural.

In addition, some reduction in visibility in areas downwind of the construction due to the increased numbers of small particles would be expected. This effect would be quite minimal. The daily generation rate of dust is 550 lbs (250 kg) (based on 180 active construction days per year). Mixed into a volume of 2.5 mi^3 (10.4 km^3) represented by a wind blowing across the trench line at low speed and a mixing depth of 330 ft (100 m), the amount of additional dust suspended in the atmosphere is about $24 \text{ } \mu\text{g}/\text{m}^3$. This much added dust will have no perceptible effect on visibility (Ettinger and Royer, 1972).

Noise (3.3.3.1.2). Construction related activities will generate noise which is expected to increase the daytime sound levels in the vicinities of the CSAs. Construction noise is associated with both equipment operating on site as well as the access and egress of equipment, material and workers.

Construction of the MX facility will take place over a period of approximately two years. The initial activities generally include ground clearing and grading of the site. Site excavation, foundation pouring, backfill operations and the erection of steel structures usually follow site preparation. These construction activities are then followed by machinery installation, equipment testing, and system checkout.

Construction equipment is expected to be used on a first-shift, 40-hour per week basis. Little construction work is planned to take place outside of this time period. It is probable, however, that certain activities, such as continuous concrete pouring or the operation of pumps to remove excess water from foundation holes could occur later than the first shift.

Construction equipment will be brought to the site as required, during the various phases of activity. Based upon past experience, it is expected that equipment from the following partial list will be used:

Site preparation - self-propelled scrapers and graders, front-end loaders, backhoes, bulldozers, trucks and compactors.

Excavation phase - motor driven air compressors, air drills, backhoes, front-end loaders, bulldozers, small cranes, jack hammers, several trucks and water pumps.

Concrete pouring and steel erection - concrete pumps, concrete trucks, vibrators, derricks and mobile cranes, asphalt pavers, miscellaneous delivery trucks, riveting and welding equipment, saws, grinders and portable generators.

Installation and check-out - trucks, cranes, welding, pneumatic tools, portable air compressors and electric generators, motors, pumps, valves, piping system blow-out equipment, and warning horns, bells, or alarms.

Within these construction phases, many pieces of equipment are powered by diesel engines, which are the dominant noise sources (based on the number of units operating and their noise levels).

Thus, the full range of construction equipment (from a noise generating standpoint) can be divided into two general categories:

- diesel-powered equipment, whose principal noise source is the engine
- all remaining equipment and noise sources

On the construction site, the localized peak construction-related noise can conceivably reach as much as 100 dBA. Typical noise ranges for a limited sample of construction equipment is shown in Figure 3-15. Note that these noise ranges were measured approximately 50 ft (15 m) from the equipment. Most of this equipment will be used during the construction phase.

In spite of the fact that fairly high noise levels will be generated from time to time at the CSAs, these sounds will attenuate, due to hemispherical spreading, air and ground absorption and changes in terrain, such that no acoustic impact is expected at any of the more populated areas on or off the base for standard day conditions (prevailing daytime winds are from the northwest for all sites). The situation is even better during night and early morning hours since the winds generally shift and blow toward the ocean. Only minimal construction activity is expected during these hours.

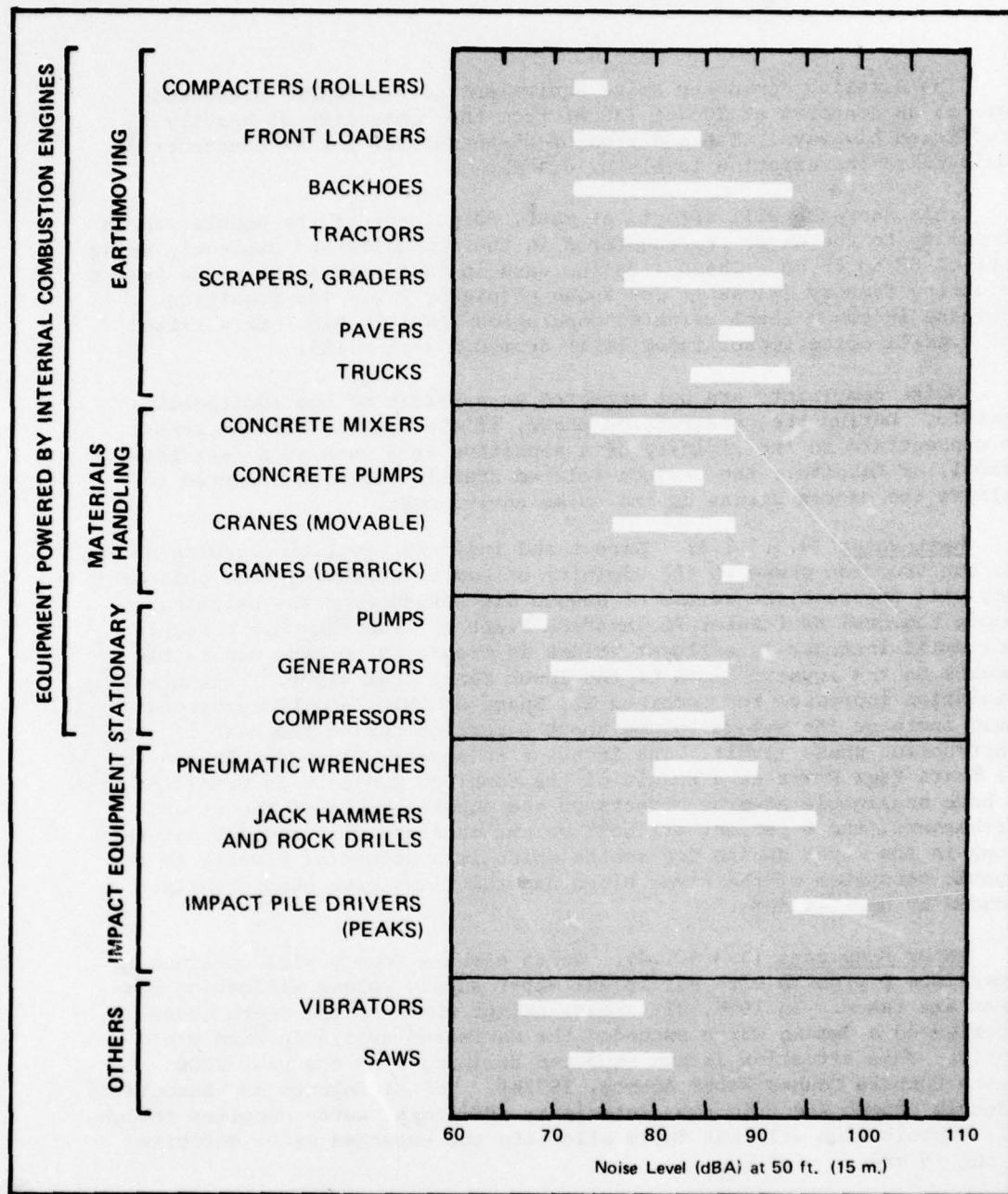
The conclusion of no acoustic impact at population centers due to construction activities is based upon the fact that major construction noise normally does not exceed a CNEL of 45-50 dB beyond a distance of one-half mile (0.8 km) from the noise sources.

The additional traffic flow of passenger cars due to construction workers is estimated to be approximately 100 vehicles per day. The maximum expected volume of truck traffic for material hauling is about 80 truckloads per day to and from the material sources to the CSA.

It is assumed that the 100 passenger cars will be arriving during the hour before the start of the first shift and will be leaving the construction area during the hour following this shift. In each case the traffic volume can be assumed to be 100 cars per hour for the access and egress times. Also, assuming that vehicle speeds average 50 mph (80 kmh) along access roads and 15 mph (24 kmh) along city streets, average noise levels due to the passenger vehicles is 59 dBA 50 ft (15 m) from open roads, and 56 dBA 50 ft (15 m) from city streets during the two hourly commuting periods.

The truck traffic increase of 80 truckloads per day implies 160 trucks pass at a given point along the route. This becomes 20 trucks per hour of traffic volume during the working day. Again, assuming average speeds of 50 mph (80 kmh) along open roads and 35 mph (56 kmh) along city streets, the estimated areal noise level due to these additional 80 trucks is 60 dBA 50 ft (15 m) from open roads and 63 dBA 50 ft (15 m) from city streets during the regular working day. At 100 ft (30 m) from the traffic lanes, these levels will all be reduced by 5 dB.

Combining these data and extrapolating over a 24-hour period yields the CNEL values to be used in evaluating impact. Thus, the construction-related traffic on open roads will result in a CNEL of 58 dB at 50 ft (15 m) or 55 dB at 100 ft (30 m); along the city routes, a CNEL of 59 dB at 50 ft (15 m) or 56 dB at 100 ft (30 m).



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Figure 3-15. Noise ranges of a limited sample of construction equipment (EPA, 1971).

The existing Community Noise Equivalent Levels (CNEL) presented have 65 dB contours at 100 ft (30 m) from the centerline of heavily trafficked highways. The addition of 55-56 dB CNEL for MX construction would raise the existing levels by 0.4 dB.

This increase will affect, at most, 30 percent of the population in proximity to the major thoroughfares in the community and presently being CNEL of 60 to 65 dB. The 0.4 dB increase in CNEL raises the noise impact weighting factor [W(CNEL)] for those people by 0.2. The resulting increase in sound level weighted population (LWP) is 618. This raises the overall noise impact index (NII) from 0.174 to 0.180.

Noise complaints are not expected as a result of the additional traffic. During the construction phase, if the traffic flow happens to concentrate in the vicinity of a sensitive area such as a rest home, school, or hospital, the project-related traffic could be rerouted to relieve the excess stress on the noise environment.

Wastewater (3.3.3.1.3). Direct and indirect population growth during the construction phase in the vicinity of Lompoc resulting from this project will increase the volume of sewage discharged from the existing Lompoc Regional Wastewater Reclamation Plant by less than 0.5 percent. This small increase in effluent volume is predicted to have negligible impacts on the aquatic biota of the lower Santa Ynez River. Estimated population increases for combined MX, Space Shuttle, and LNG projects would increase the sewage volume about 6 percent during the peak of the construction phase (1981). The increase in sewage volume discharged to the Santa Ynez River as a result of the combined projects is predicted to have negligible adverse effects on the aquatic biota of the river. Furthermore, the 6 percent effluent volume increase will augment natural flows in the river during dry months which is a potential benefit to the aquatic ecosystem of the river since natural flows have been greatly reduced by upriver dams.

Water Resources (3.3.3.1.4). Santa Barbara County will continue to experience a problem with sufficient water supply unless mitigation measures are taken. In 1975, all areas, except parts of the South Coast experienced a demand which exceeded the estimated available firm yield supply. This situation is not expected to improve by the year 2000 (Santa Barbara County Water Agency, 1977b). The Livingston and Associates moderate growth scenario does anticipate additional water supplies though full exploitation will not fully alleviate the expected water deficits in the future.

MX construction-related per capita water consumption impacts are attributable to two primary factors: 1) the in-migration of construction-related personnel, and 2) the use of water used in actual construction.

Countrywide, the projected demand for water in 1981 based upon municipal, agricultural, and industrial need is 253,400 acre-ft/yr ($3.1 \times 10^8 \text{ m}^3/\text{yr}$) (Santa Barbara County Water Agency, 1977c). MX construction-related water demand for Santa Barbara County in 1981 is expected to be an additional 109 acre-ft/yr ($134 \times 10^3 \text{ m}^3$) 0.04 percent increase). This figure relates solely to increased municipal and industrial needs. No agricultural demand for water as a result of MX construction is expected to occur. Each urban area's additional demand for water as a result of MX construction is given in Table 3-50 Vandenberg will require an additional 49 acre-ft/yr ($60 \times 10^3 \text{ m}^3$); the Lompoc area, 8 acre-ft/yr ($9,800 \text{ m}^3$); the Santa Maria-Orcutt area, 15 acre-ft/yr ($18,500 \text{ m}^3$); the Santa Ynez Valley, 2 acre-ft/yr ($2,500 \text{ m}^3$), and the South Coast, 36 acre-ft/yr ($44,500 \text{ m}^3$).

The water needs for MX construction phase, however small, will further increase the growing divergency between water supply and demand unless increased conservation efforts are practiced or supplemental sources of water are obtained.

Operations Phase (3.3.3.2)

Air Quality (3.3.3.2.1). The missile flight tests themselves will generate exhaust effluent clouds that require controlled safety zones out to distances of a few thousand feet ($\pm 1,500 \text{ m}$) from the launch points. total amount of material released into the atmosphere as well as the portion near the ground is not accurately known at this time because MX missile design has not been finalized. However, the estimated impact for the missile which is larger than a Minuteman and smaller than a Titan III, would be bracketed by them since it uses the similar propellant. Although both missiles are launched routinely from Vandenberg, no residual country-wide impacts have been observed from either. Air quality effects from the MX launches may extend beyond the boundaries of the base, but pollutant amounts are estimated to be very low. Higher pollutant levels in the immediate vicinity of the launch point do occur, but monitoring on the Titan III program has not resulted in any detectable air quality effects from the much larger missile.

The effects on air quality of missile exhaust products are adverse in that they degrade clean air by adding additional pollutants to it. The transient and limited nature of the missile exhaust trail is due to the rapid dilution affected by the atmosphere. High dilution ratios strongly limit the potential impacts since the simultaneous launches are not expected due to range safety restrictions on launch intervals. A minimum of 12 hours will normally occur between launches. Therefore, additive effects are not anticipated. Impacts on the countywide air quality are projected to be minimal.

Table 3-50. MX construction water use projections in acre-ft/yr, 1981.

AREA	1975 ^a USAGE	1981 ^b PROJECTION	MX 1981	SHUTTLE 1981	LNG 1981
VAFB ^{c,d}	5,040 (6.2 x 10 ⁶)	6,500 (8.0 x 10 ⁶)	49 (6 x 10 ⁴)	1,800 ^f (220 x 10 ⁴)	— —
			0.75 ^e	27.7	—
Lompoc	34,800 (43 x 10 ⁶)	36,500 (45 x 10 ⁶)	7 (0.9 x 10 ⁴)	328 (40 x 10 ⁴)	88 (10.8 x 10 ⁴)
			0.02	0.9	0.24
Santa Maria/Orcutt	114,500 (141 x 10 ⁶)	120,500 (149 x 10 ⁶)	15 (1.9 x 10 ⁴)	409 (50 x 10 ⁴)	166 (20.3 x 10 ⁴)
			0.01	0.34	0.14
Santa Ynez Valley	34,300 (42 x 10 ⁶)	37,100 (46 x 10 ⁶)	2 (0.3 x 10 ⁴)	82 (10 x 10 ⁴)	28 (3.4 x 10 ⁴)
			0.005	0.22	0.08
North County	188,640 (233 x 10 ⁶)	200,600 (247 x 10 ⁶)	73 (9 x 10 ⁴)	2,619 (320 x 10 ⁴)	282 (34.5 x 10 ⁴)
			0.04	1.31	0.14
South Coast	48,900 (60 x 10 ⁶)	52,800 (65 x 10 ⁶)	36 (4.4 x 10 ⁴)	589 (72 x 10 ⁴)	397 (48.6 x 10 ⁴)
			0.07	1.12	0.75
County Total	237,540 (293 x 10 ⁶)	253,400 (313 x 10 ⁶)	109 (13 x 10 ⁴)	3,208 (392 x 10 ⁴)	679 (83 x 10 ⁴)
			0.04	1.27	0.26

^aAll acre-feet (m³) except for Vandenberg, are figured on 200 gpd (0.76 m³) per capita consumption.

^bWithout projects.

^cFigures for 1975 and 1981 are based upon 335 gpdpc (1.27 m³) (Santa Barbara County Water Agency, 1977).

^dFigures for MX are based upon water demand projections for commuting personnel [100 gpdpc (0.38 m³)] and project construction needs. Figures for Shuttle are based upon water demand projections for commuting personnel.

^eThis figure and all figures in the bottom half of each box represent the percentage of contribution to the 1981 water use projections in each area.

^fFigure based upon data in Santa Barbara County Water Agency Report, p. III-55, October 1977.

Distribution of Vehicle Emissions. Vehicle emission levels for Vandenberg and the surrounding areas were estimated based on projected vehicle miles traveled (VMT) for both current activity on the base and increased activity resulting from the MX testing program. Using emission factors listed in the Environmental Protection Agency publication AP-42, the estimated VMT were converted into pollutant emission values. Carpool studies and vehicle counts were used to estimate the VMT along segments of major traffic arteries on and to the base. Within commercial, city, and residential areas on and off the base, the VMT were estimated based on population figures, an average number of vehicle operators per population and an average VMT per number of vehicle operators during the peak hour of traffic. Estimates of emissions from the Southern Pacific Railroad, which travels along the western edge of Vandenberg, were based on the number of trains per day and the emission factors for diesel locomotives listed in the Environmental Protection Agency publication AP-42.

In analyzing the results of the vehicle emissions, it is possible to look at several pollutants, including a secondary pollutant, photochemically-formed ozone; and some choices to simplify the problem can be made. Initially, two pollutants, carbon monoxide (CO) and nitrogen oxides (NO_x) have been used to provide an idea of the extent and location of pollution. Two meteorological regimes are considered. Ozone was not modeled, as the validity of assumptions concerning precursor levels and existing background ozone concentrations was uncertain enough to make this a poor choice as an impact indicator. Instead, the primary emissions of CO and NO_x for which only low background values, if any, exist at Vandenberg, were chosen for the model runs. Hydrocarbons were not modeled nor was SO_2 because of the probable existence of sources of unknown magnitude of both pollutants in the oil fields near Santa Maria and from the crude oil processing plant south of Santa Maria. Until better information is available on these sources, it was felt prudent not to attempt an impact analysis using them.

Figure 3-16 presents the impact model outputs for CO in the form of isopleths of concentration superimposed on a map of Vandenberg (SAI, 1977). Figure 3-16A and Figure 3-16B give the baseline CO concentrations for Vandenberg for an early morning and an afternoon case respectively without MX related emissions. In the morning, the low levels of CO are spread generally throughout the area by light drainage winds with relatively high value in the northeast corner of the map where traffic is moving through the Orcutt area. The Vandenberg industrial area shows a small maximum as does downtown Lompoc. In the afternoon, the typical west-northwest winds extend the maximum isopleths eastward somewhat and decrease the central values by a factor of five due to the increased wind speed, turbulence, and mixing. The Lompoc maximum is also moved eastward and reduced. In Orcutt, the high morning value in excess of 3.5 ppm is reduced to a value much less than 1 ppm, as the mixing in that area increases. The NO_x (Figure 3-17A) baseline pattern shows much of the same distribution with a broad flat morning

distribution over Vandenberg, due to the widely dispersed traffic flow and light winds. The maximum concentration of NO_2 near Orcutt is slightly displaced from the one for CO partly as a result of the different isopleth values chosen for plotting for each pollutant and partly as a result of the way in which the gridded emission values were initially assigned. The afternoon values of NO_x (Figure 3-17B) show very small concentrations with a generally eastward drift and less obvious maxima than do the CO values. The very small values resulting from mixing make the distribution less dramatic than the one for CO.

Neither the CO nor the NO_x maxima shown for the higher morning case approach the National Ambient Air Quality standards. In fact, for the conservatively projected Vandenberg 1985 traffic levels used here, the impact is so low as to be negligible.

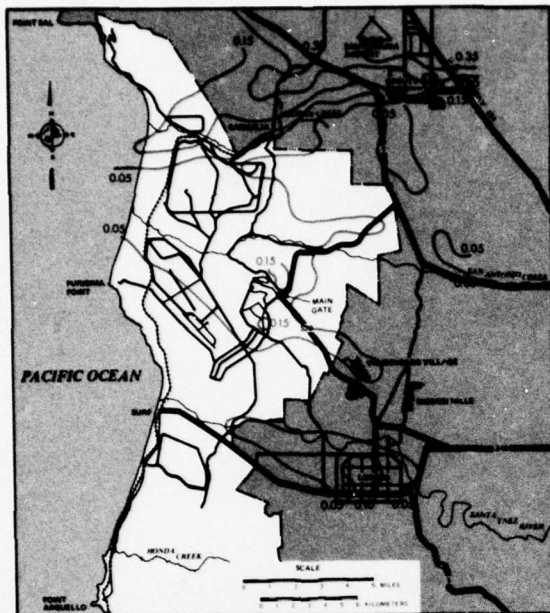
The MX project increments for NO_x for the morning and afternoon cases are shown in Figure 3-17C and D. For each time of day, these additional project related pollutant concentrations show strikingly similar distributions. The reason for this is that the concentrations are modeled using vehicle emissions as the primary input. Area emissions related to the present populations in Lompoc and the other towns around Vandenberg would be expected to increase with more people in the area. Estimates for the model were based on present emission values as the magnitude of projected increases was felt to be too uncertain.

The maximum values shown for the project are modeled on a relatively conservative basis and, for both the CO and NO_x , are about a factor of ten below the baseline values.

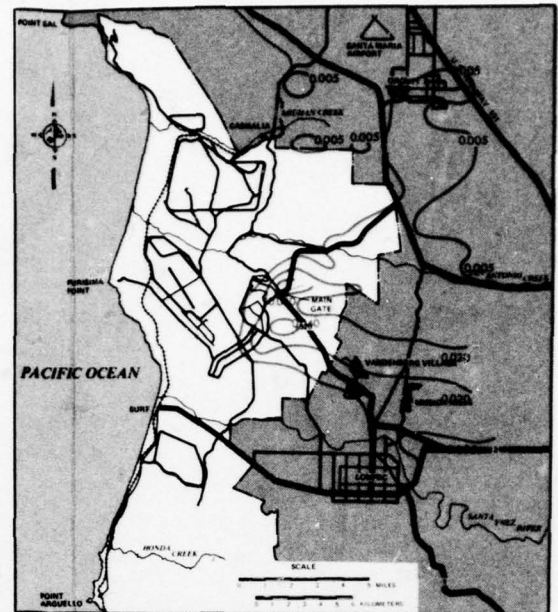
Part of the conservatism in the project emissions estimates comes from the routing of all project traffic along the most congested routes and through the heavily traveled Vandenberg industrial area. Also, peak hour vehicle counts were used under the assumption that they were representative of several successive hours, so that the model output values compute a "steady state" result. This maximizes the model output values and with the routing used, provides a most conservative projection during the time the MX program would be operating on Vandenberg.

Noise (3.3.3.2.2). Operation of the MX at Vandenberg will create additional noise which is attributed to three sources: automobile traffic, sonic booms, and missile propulsion.

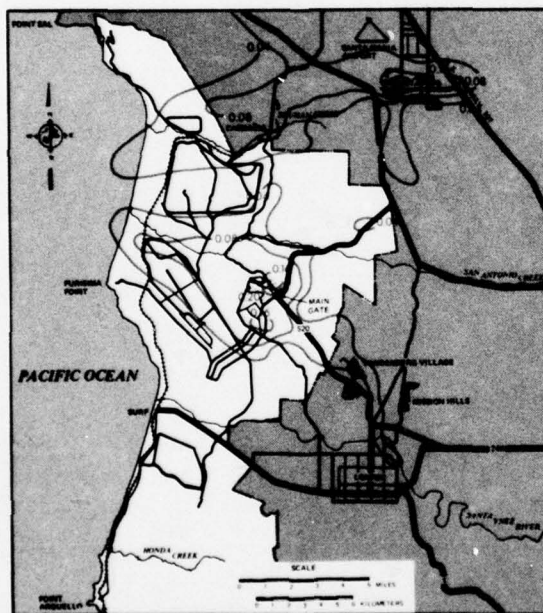
Additional automobile traffic associated with MX operations will be minimal. The increase in CNEL in the Vandenberg area and its vicinity is not expected to exceed 1 dB. This small increase will not be perceptible to the population in proximity to the major thoroughfares in the community and presently being exposed to CNEL of 60 to 70 dBA.



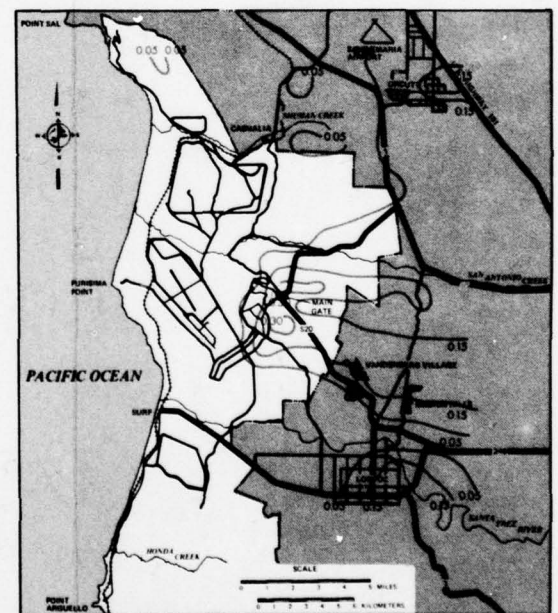
A MORNING CO BASELINE



B AFTERNOON CO BASELINE



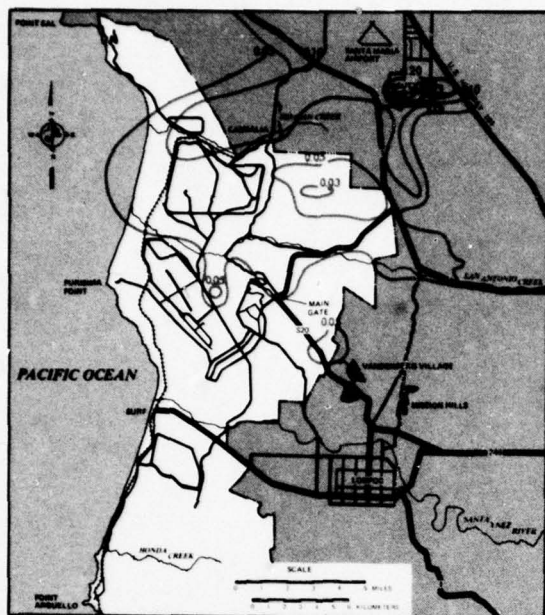
C MORNING CO INCREMENTS



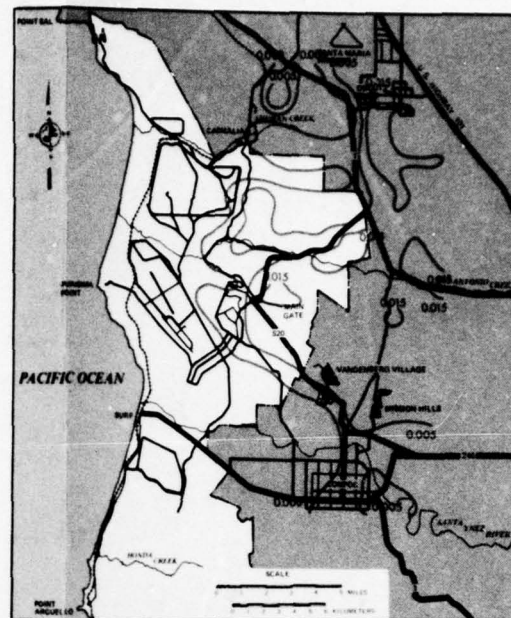
D AFTERNOON CO INCREMENTS

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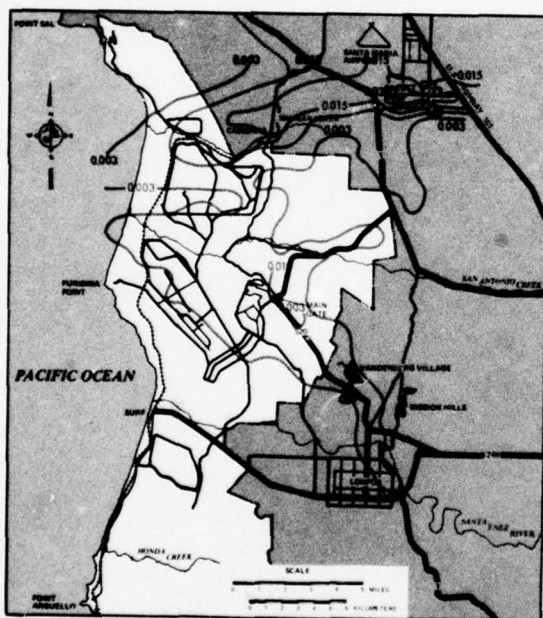
Figure 3-16. Morning and afternoon carbon monoxide baseline conditions and incremental additions associated with MX.



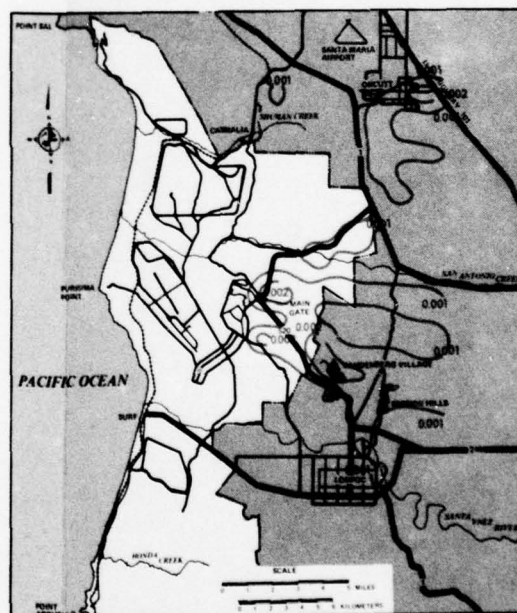
A MORNING NO_x BASELINE



B AFTERNOON NO_x BASELINE



C MORNING NO_x INCREMENTS



D AFTERNOON NO_x INCREMENTS

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Figure 3-17. Morning and afternoon nitrous oxide baseline conditions and incremental additions associated with MX.

Sonic booms will be sensed primarily off the coastline when missile speed exceeds the speed of sound [around 1,100 fps (335 m/s)]. Based on previous experience with Minuteman II, the first boom will not intersect the ground until 15 to 24 mi (24 to 38 km) from the launch site (Science Application Incorporated, 1974). Because the missile will only use over-water launch azimuths, these booms are not expected to affect land areas. The westerly launch azimuth is such that these booms will not impact the Channel Islands.

The noise from missile propulsion requires detailed analysis to assess the environmental impact with and without MX. Currently, the most frequent launches are of Minuteman II and III and Titan III missiles. The 33 launches in 1977 were comprised of 20 Minuteman, 4 Titan III, and 9 other missiles. This level of activity will increase due to the Space Shuttle for the time span covered by this report. A concurrent launch of both the MX and Space Shuttle is, however, not possible due to range safety requirements. Hence, cumulative effects are not anticipated.

A number of sources of measurement data and methods of noise level prediction are available in the literature. In the following paragraphs, these data sources are discussed and are used to estimate the noise impact from MX firings. An approximate empirical relationship between the overall sound pressure level of a rocket and its thrust is shown in Figure 3-18. Assuming inverse square propagation spreading, this figure would suggest that at a 1 mi (1.6 km) distance, the Minuteman and Titan missiles would generate overall sound pressure levels of 120 dB and 130 dB, respectively. The later figure is in agreement with the measured levels for two Titan III launches.

Discussion of noise impacts must consider divisions of acoustical energy frequency range due to differing degrees of human responses which occur at various frequencies. Sound fields generated by chemical rocket engines contain energy in the following areas:

- infrasonic - inaudible frequency region below 20 Hz
- audible - audio frequency range between 20 and 20,000 Hz
- ultrasonic - frequencies above the 20,000 Hz high frequency detection capability of the human ear

Typically, the larger the chemical rocket engine in terms of its physical size and its thrust level, the larger the portion of total acoustic energy that is contained in the low frequency components of the spectrum.

Octave band spectrum data relating to the Minuteman missile is shown in Figure 3-19. Most of the acoustic energy is concentrated in frequency bands lesser than 63 Hz, or in the infrasonic range. The proposed MX vehicle engine is larger and has a higher thrust level than Minuteman with additional acoustic energy contained in the infrasonic range. Comparison of this spectral energy distribution and the Air Force

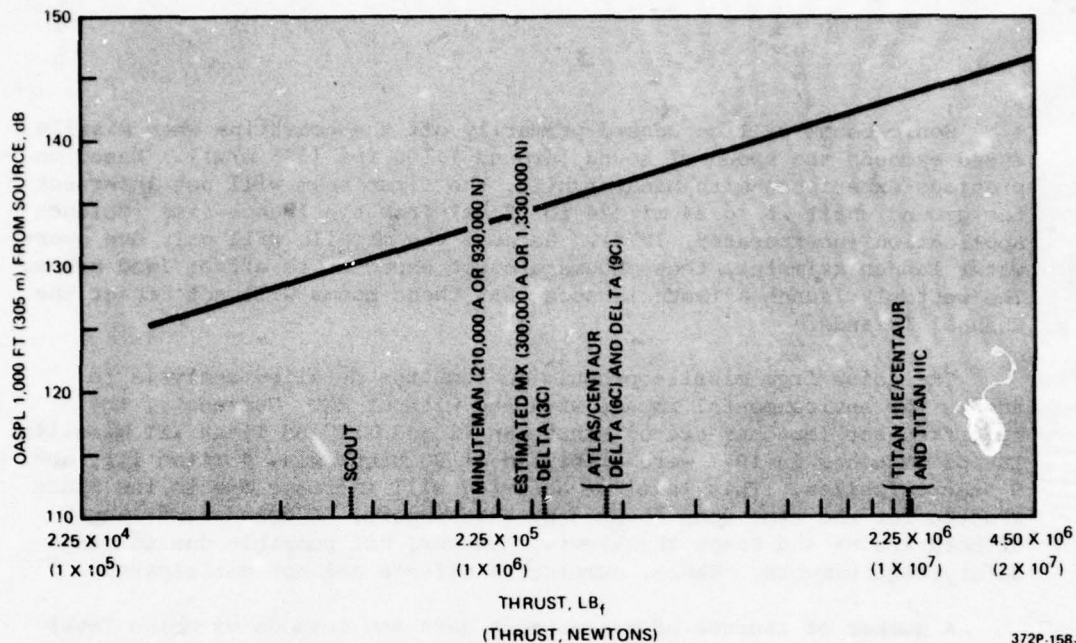


Figure 3-18. Appropriate relationship between rocket engine thrust and sound pressure level at 1,000 ft (305 m) (after Regier, 1962).

guidelines for unprotected exposure of humans to low frequency noise (presented in Table 3-51), indicates that no excessive exposure to low frequency noise is expected from MX test operations except in the immediate vicinity of the launch pad [less than 1 mi (1.6 km)]. This area is controlled, and nonauthorized personnel are excluded from the site during launch operations. The theoretical instantaneous noise contours, assuming no terrain blockage for all four CSAs, are presented in Figures 3-20 through 3-23.

There are two possible launch angles, vertical launch and 45° angle launch. The influence circle may well be affected by the terrain blockage between the missile and the receiver. The primary receivers in the vicinity of Vandenberg AFB are Orcutt, Casmalia, Vandenberg Village, Lompoc, and Santa Maria. The important terrain blockages of acoustic propagation are Casmalia Hills and Purisima Hills. The Federal Correctional Institution has a large full-time concentration of residents adjacent to VAFB that could be impacted by noise levels from both the Space Shuttle and MX launches.

For comparative purposes, however, the average noise level predictions should prove adequate and they will, therefore, be used as the basis for the MX impact analysis. In discussing the environmental impact of the MX, the USAF will assume that the MX will exhibit a sound level versus distance characteristic similar to that of Minuteman.

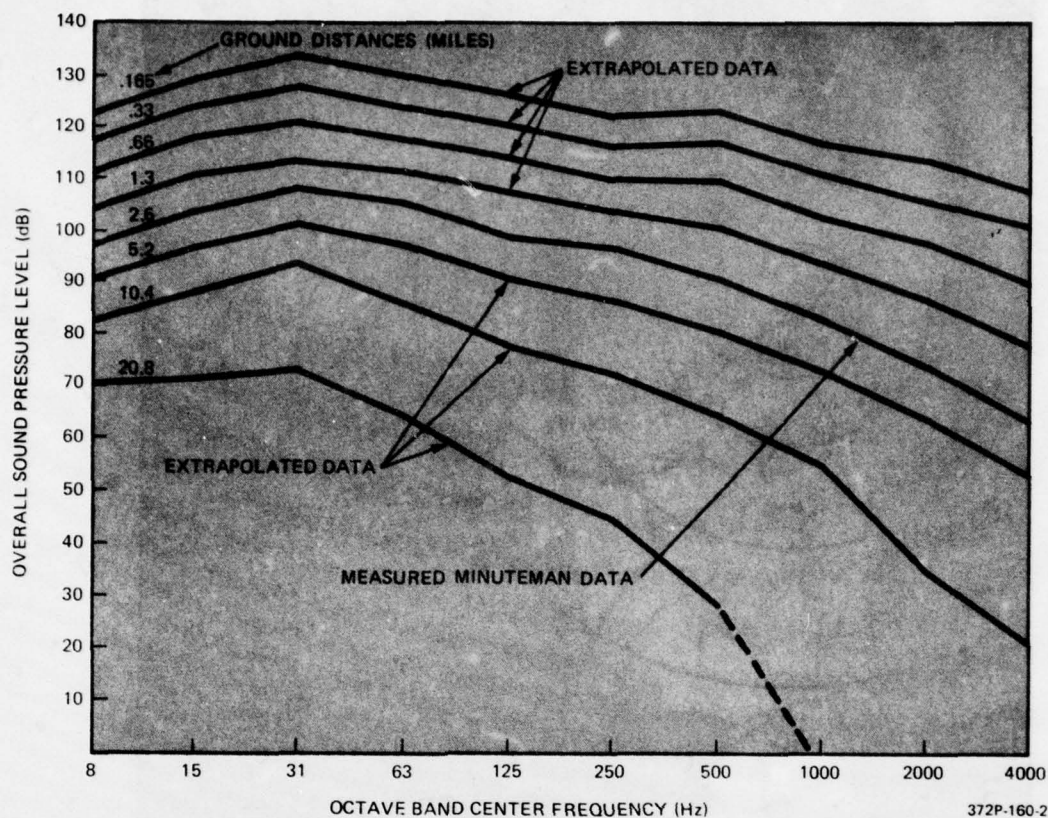
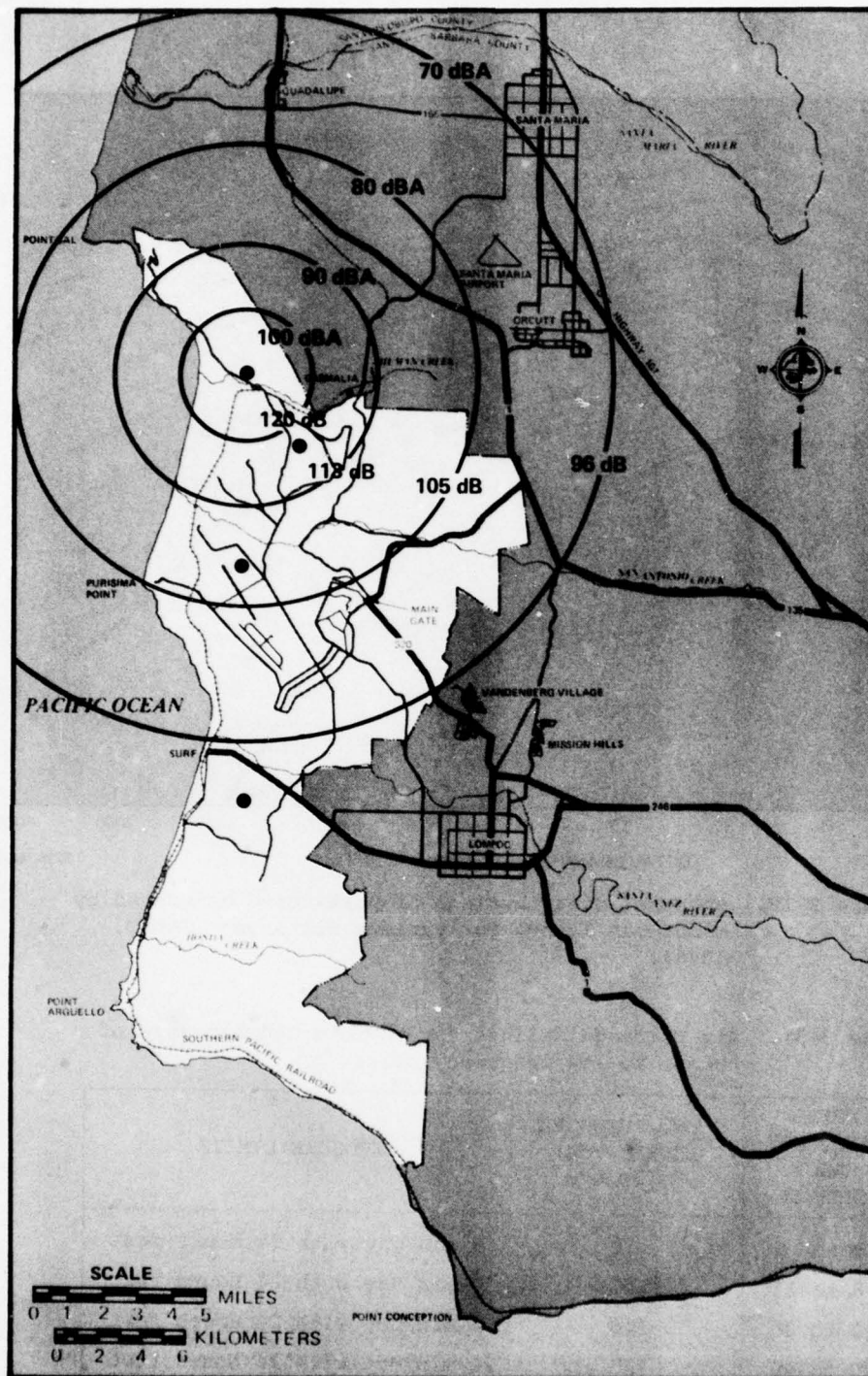


Figure 3-19. Spectral distributions of peak noise generated by Minuteman launch for various distances (SAMSO, 1976).

Table 3-51. Air Force guidelines for unprotected exposure of humans to low frequency noise.

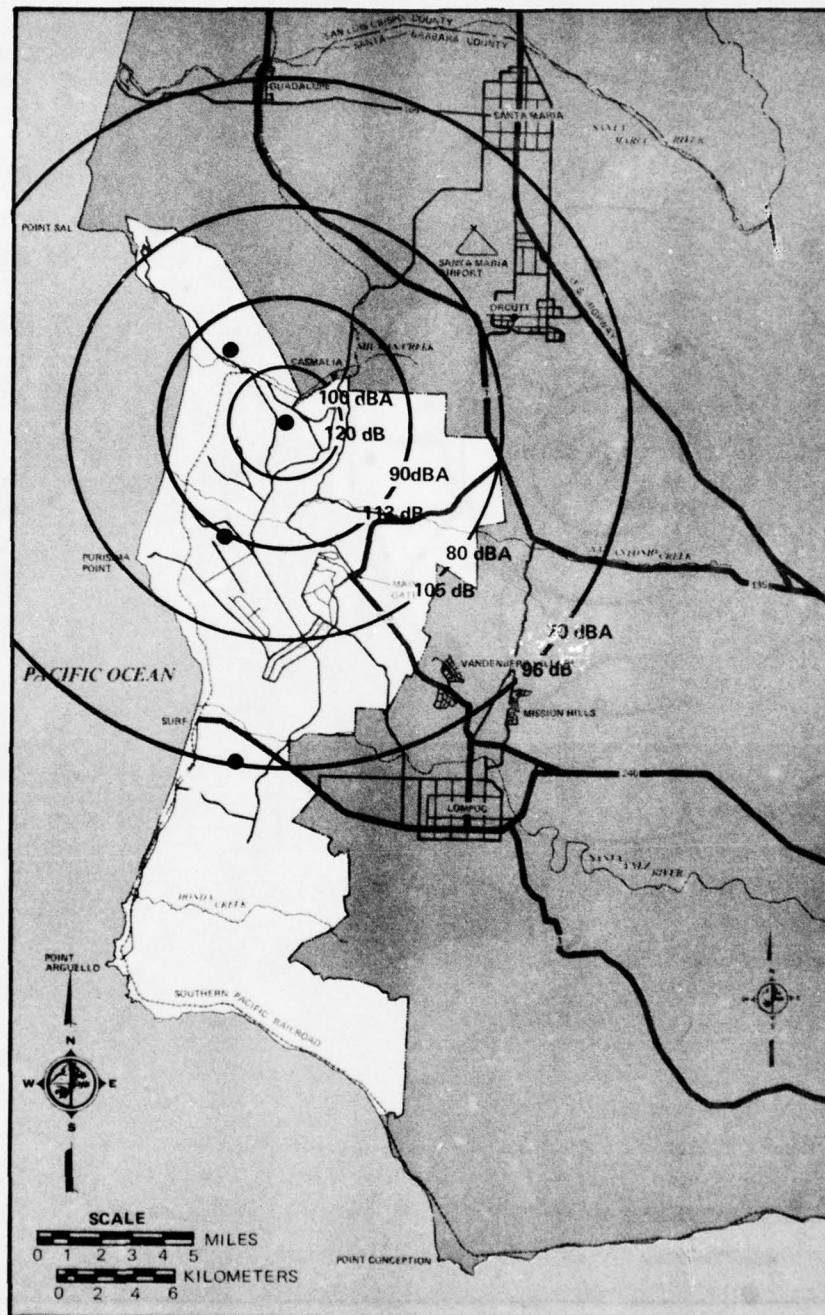
NOISE FREQUENCY RANGE (HERTZ)	SOUND PRESSURE LEVEL ¹ (dB) (re: 20 N/m ²)	EXPOSURE LIMITS
1 to 7	150	4 min/day with 24 hours rest
8 to 11	145	4 min/day with 24 hours rest
12 to 20	140	4 min/day with 24 hours rest
20 to 80	135	20 min/day with 24 hours rest

¹Sound pressure levels apply to discrete single frequencies or to bands of noise including the stated frequencies.



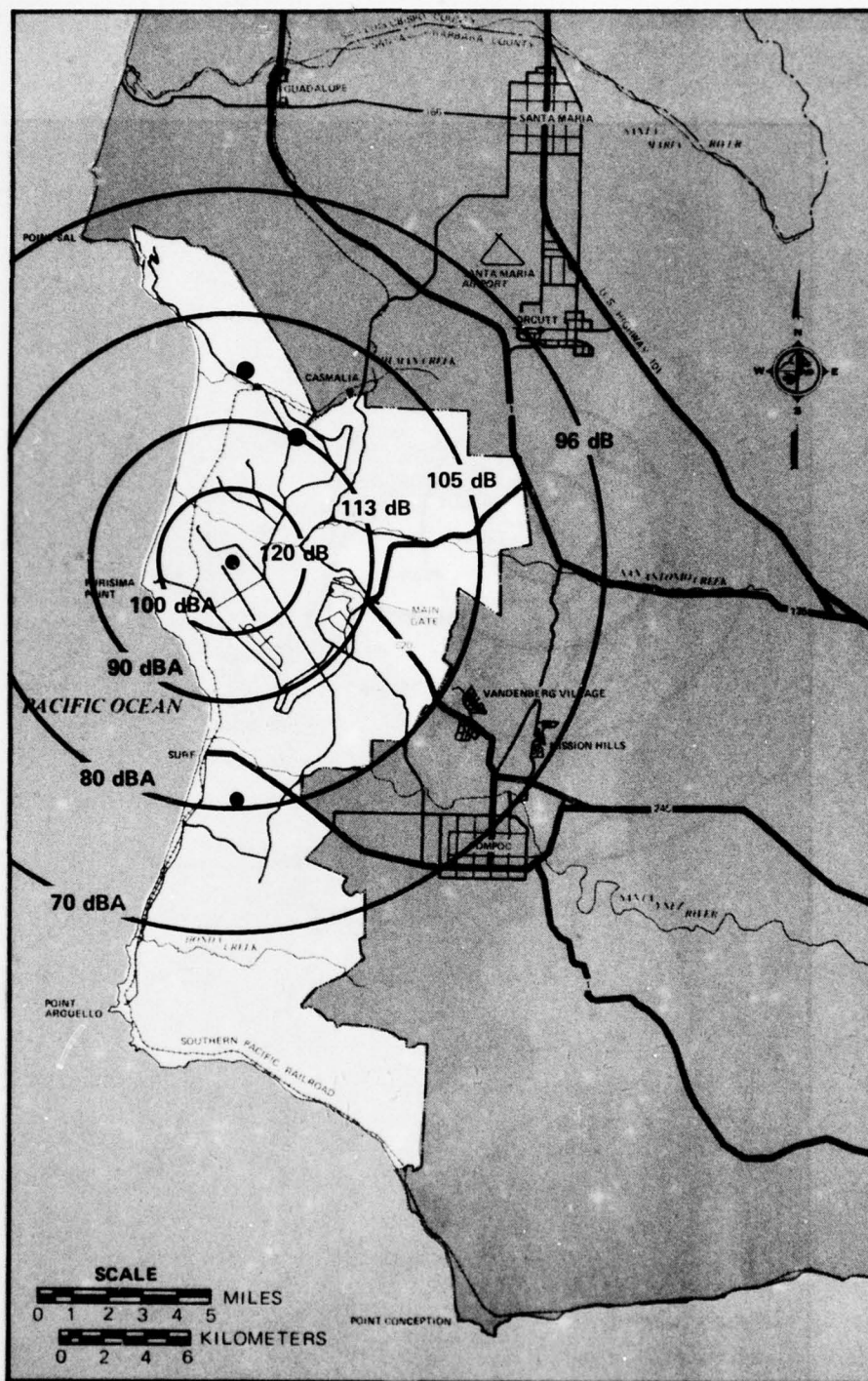
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Figure 3-20. Estimated maximum noise levels for the Shuman Canyon CSA.



372P-162-3

Figure 3-21. Estimated maximum noise levels for the San Antonio Terrace CSA.



372P-164-3

Figure 3-22. Estimated maximum noise levels for the Burton Mesa CSA.

Table 3-52 summarizes the maximum sound pressures which are likely to be experienced at various population centers due to missile firings. In the table, both the overall and A-weighted sound pressure levels are presented. These sound pressure levels are provided for MX firings from all the four candidate siting areas. Sound pressure levels are also presented for the Minuteman, Titan, and the Space Shuttle firings for comparison with MX.

The estimated annual frequency¹ of launchings at Vandenberg is given by the decibel (antilogarithmic) addition of CNELs of the individual events:

		<u>DAY</u>	<u>EVENING</u>	<u>NIGHT</u>
Minuteman:	20 per year	16	2	2
Titan:	4 per year	3	0	1
MX:	5 per year	3	1	1
Shuttle:	16 per year	12	2	2

The combined annual average of all launchings at Vandenberg is given by the decibel (antilogarithmic) addition of the CNELs of the individual events. The peak sound level from a typical launch is estimated to have a duration of approximately 20 seconds. On the basis of these elements, the annual average CNELs contributed by each of the vehicle categories at the most exposed are calculated to be as follows:

Minuteman:	CNEL	20	at	Guadalupe
Titan:	CNEL	22	at	FCI
Shuttle:	CNEL	31	at	FCI
MX-Shuman Canyon:	CNEL	37	at	Casmalia
MX-San Antonio Terrace:	CNEL	45	at	Casmalia
MX-Burton Mesa:	CNEL	37	at	VAFB
MX-Lompoc Terrace:	CNEL	25	at	FCI

In the worst case, that of the San Antonio Terrace site, in the impacts upon the community of Casmalia, the annual average CNEL arising from the combined rocket firings at Vandenberg will not exceed 45 dB. This is substantially below the estimated CNEL of 55 to 69 dB which exists in Casmalia due to railroad traffic.

As a further point of reference, the 95 dBA maximum level that would occur in Casmalia due to MX launches from the San Antonio Terrace site is comparable with the levels of train noise (90 dBA) that

¹These figures represent estimates for those years during which shuttle operations and MX development will be underway. MX test launchings may be expected to double when the MX becomes operational.

Table 3-52. Estimated peak overall and A-weighted sound pressure levels at population centers due to missile firings (lasting for about 10 seconds).

LOCATION	MINUTEMAN		TITAN ¹		MX 1 ³		MX 2 ⁴		MX 3 ⁵		MX 4 ⁶		SHUTTLE	
	OA ¹	A ²	OA	A	OA	A	OA	A	OA	A	OA	A	OA	A
Santa Maria	84	53	76	44	89	59	89	58	83	50	76	42	85	49
Orcutt	88	57	82	51	97	68	98	69	90	59	83	50	89	56
Lompoc	78	43	96	69	84	51	86	54	90	59	97	68	106	76
Vandenberg AFB	87	55	99	72	97	68	100	73	110	87	100	73	104	74
Vandenberg Village	80	46	94	65	88	57	90	59	93	64	95	95	102	72
Guadalupe	97	69	78	46	99	66	93	64	87	56	78	44	86	50
Mission Hills	78	43	92	63	87	55	89	58	90	59	92	62	100	70
Federal Correction	80	46	100	73	88	57	90	60	95	66	101	75	107	77
Casmalia	95	66	86	55	110	87	115	95	100	73	90	59	93	61

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¹OA = overall sound pressure level in dB.

²A = A-weighted sound pressure level in dBA.

³MX firing from the Shuman Canyon CSA.

⁴MX firing from the San Antonio CSA.

⁵MX firing from the Burton Mesa CSA.

⁶MX firing from the Lompoc Terrace CSA.

occur at a distance of 50 ft (15 m) from the railroad. The duration of train noise would be substantially longer than the 20 seconds assumed for the duration of the maximum noise levels during missile firings.

Wastewater (3.3.3.2.3). Direct and indirect population growth in the vicinity of Lompoc resulting from this project will increase the volume of sewage discharged from the existing Lompoc Regional Wastewater Reclamation Plant by less than 0.5 percent during testing phases of the project. This small increase in effluent volume is predicted to have negligible impacts on the aquatic biota of the lower Santa Ynez River. Estimated population increases for combined MX and Space Shuttle projects would increase the sewage volume about 2 percent at the combined peak for the two projects (1985). The increase in sewage volume discharged to the Santa Ynez River as a result of the combined projects is predicted to have negligible adverse effects on the aquatic biota of the river.

Water Resources (3.3.3.2.4). MX operations-related water consumption impacts are attributable to three primary factors:

- The permanent relocation of MX operations personnel and their families to Santa Barbara County from outside areas.
- Relocates seeking to take advantage of employment generated indirectly as a result of MX.
- The water requirements related directly to testing operations.

As indicated in Table 3-53, the 1985 total projected demand for water in Santa Barbara County without MX is 256,000 acre-ft ($3.2 \times 10^6 \text{ m}^3$) (Santa Barbara County Water Agency, October 1977). The countywide increase in water demand as a result of MX operations is anticipated to be an additional 599 acre-ft ($7.4 \times 10^5 \text{ m}^3$). This is approximately 75 percent of the additional demand created by the Space Shuttle project countywide. The impact on water demand for each area of Santa Barbara County as a result of MX flight testing is estimated to be:

- Vandenberg - 65 acre-ft ($8 \times 10^4 \text{ m}^3$)
- Lompoc - 180 acre-ft ($2.2 \times 10^5 \text{ m}^3$)
- Santa Maria-Orcutt - 180 acre-ft ($2.2 \times 10^5 \text{ m}^3$)
- Santa Ynez Valley - 39 acre-ft ($4.8 \times 10^4 \text{ m}^3$)
- South Coast - 135 acre-ft ($1.7 \times 10^5 \text{ m}^3$)

The majority of the communities within the county experienced a demand for water which exceeded the supply in 1975 (see Table 1-29) and this is not expected to improve by the year 2000 (Santa Barbara County Water Agency, 1977b). Therefore, unless supplemental sources or water

Table 3-53. MX operations phase water use projections in acre-ft/year, (cubic meters), 1985.

AREA	1975 USAGE	1985 ^a PROJECTION	MX ^d 1985	SHUTTLE ^d 1985
Vandenberg ^b	5,040 (6.2 x 10 ⁶)	6,500 (8.0 x 10 ⁶)	65 ^c (8 x 10 ⁴)	500 ^e (62 x 10 ⁴)
			1.0	7.7
Lompoc	34,800 (43 x 10 ⁶)	38,200 (47 x 10 ⁶)	180 (22 x 10 ⁴)	90 (11 x 10 ⁴)
			0.47	0.24
Santa Maria/Orcutt	114,500 (141 x 10 ⁶)	121,200 (149 x 10 ⁶)	180 (22 x 10 ⁴)	90 (11 x 10 ⁴)
			0.47	0.24
Santa Ynez Valley	34,300 (42 x 10 ⁶)	33,700 (42 x 10 ⁶)	39 (5 x 10 ⁴)	20 (2.5 x 10 ⁴)
			0.12	0.06
North County	188,640 (233 x 10 ⁶)	199,600 (246 x 10 ⁶)	464 (57 x 10 ⁴)	700 (86 x 10 ⁴)
			0.23	0.35
South Coast	48,900 (60 x 10 ⁶)	56,600 (70 x 10 ⁶)	135 (17 x 10 ⁴)	68 (8 x 10 ⁴)
			0.24	0.12
County Total	237,540 (293 x 10 ⁶)	256,200 (316 x 10 ⁶)	599 (74 x 10 ⁴)	768 (95 x 10 ⁴)
			0.23	0.29

^aWithout projects.

^bFigure for 1975 based on 335 gpd (1.27 m³) per capita consumption rate (Santa Barbara County Water Agency, October 1977).

^cFigure for 1985 based on projections of water use by commuting personnel (580) at 100 gpdpc (0.38 m³).

^dAll figures in the bottom half of each box represent the percentage of contribution to the 1985 water use projections in each area.

^eFigure based upon data in Santa Barbara County Water Agency Report, p. III-55, October 1977.

are attained or local water resources yield-potential is maximized, or maximum conservation efforts are practiced, the MX project will further increase the deficiency of supply in the surrounding area.

The water supply at Vandenberg is not seen to be a serious problem during either the construction or operation phase. This is because of the relatively small increase in the water demand (0.75 percent for construction and 1 percent for operations). The San Antonio aquifer and the Lompoc Terrace aquifer are expected to yield adequate well water to meet the demand within the base to at least the year 2000.



Alternatives

4

ALTERNATIVES TO THE PROPOSED ACTION

Alternatives considered for the proposed action include:

- No project
- Reduction in the number of flight tests
- Flight tests at other locations
- Construction of the project at a different scale
- Project postponement

4.1 NO PROJECT

Air Force guidance and control evaluation requirements established MX flight test sample size at 15 successful tests. An analysis of the projected MX success ratios factored by the Minuteman flight test history indicated a 23-missile flight test program. The absence of a flight test program would severely compromise weapon system evaluation. The Air Force would have to rely entirely on extensive ground testing and analysis of subsystems with a substantial reduction in the performance confidence level of the total system.

4.2 REDUCTION IN NUMBER OF FLIGHT TESTS

As noted, a 23-flight test program would be required. However, after subsequent analysis, the ICBM Program Office has reduced the program to 20 missile flights (weapon system launches) with an acceptable small increase in risk. Any further reduction in the flight test program would compromise weapon system evaluation and reduce the performance confidence level of the system until production missiles are available for test.

4.3 FLIGHT TESTS AT OTHER LOCATIONS

Vandenberg Air Force Base has been selected by the Air Force as the primary location for the MX system level ground and flight tests. There were several alternate locations which were considered to be technically acceptable for conducting the test program, but each location had negative aspects which led to its disqualification. Any change in these negative aspects or in program direction could lead to reconsideration of a particular location. The other locations considered and the reasons for their disqualifications are as follows:

- Cape Canaveral Air Force Station. Even though the uprange geometry of this area is acceptable, the Eastern Test Range capabilities (distance, sensor capabilities, etc.) are inadequate.
- Holloman AFB/White Sands Missile Range. The launch area coverage provided by this area is acceptable but this factor is outweighed by concerns due to overfly of populous areas to get to established target zones.
- San Nicolas Island. The use of San Nicolas Island would reduce launch area hazards such as would be encountered in the Vandenberg/Santa Maria/Lompoc area, but would add costly logistical and personnel problems because of the requirements to support a large test program in a remote location.

4.4 CONSTRUCTION OF THE PROJECT AT A DIFFERENT SCALE

Several alternatives are available as a means of reducing the scale of construction associated with the testing of the MX weapon system. Change in the amount of construction would cause a corresponding change in cost for the testing program. Possible options are presented below.

Use of Other Existing Buildings (4.4.1)

Although review has not shown that a large number of existing buildings are suitable or available for use in the MX testing program, the possibility remains that existing Vandenberg facilities could be obtained for specific purposes. The resulting effects from such an attempt to obtain existing facilities rather than provide new facilities appear to be as follows:

- Reduced cost.
- Reduced environmental impact due to construction.
- Possible interruption of existing programs.

- Increased scheduling problems.
- Increased logistical problems due to facilities not being assembled in a planned complex.
- Increased supervisory problems.

Reduction in Length of Trench (4.4.2)

It is anticipated that if the trench mode of deployment is selected for testing, two trenches would be constructed and that each trench would be 2 miles (3.2 km) long with additional distance being utilized for the construction of entrance ramp structures. The effects of constructing less than the proposed amount of trench are anticipated to be as follows:

- Reduced cost relative to cost with trenches of the planned length.
- Reduced environmental impact due to construction relative to impacts of trenches of planned length.
- May make additional siting areas feasible (a 1-mile [1.6 km] trench might fit Shuman Canyon where 2-mile [3.2 km] trenches do not).

Reduction in Number of Shelters (4.4.3)

It is anticipated that if the shelter mode of deployment (vertical, horizontal, or pool) is selected for testing, three shelters would be constructed. If only one or two shelters were constructed, the resulting effects are anticipated to be as follows:

- Reduced cost relative to the cost of the planned number of shelters.
- Reduced environmental impact due to construction.
- Possibly increased time lapse between tests due to repair and refurbishment of shelter.

4.5 PROJECT POSTPONEMENT

Project postponement would disrupt the scheduled development of the missile and its supporting elements delay the initial operational capability (IOC) of the MX system.

If the currently planned IOC for MX is to be maintained and the flight test program is postponed, a shorter period would be available for flight testing. If the planned number of tests (20) were to be accomplished

in this period, the launch frequency would have to be increased, thus impacting logistics and support operations. On the other hand, if the planned launch rate were to be maintained during the shortened time period, fewer flight tests would be accomplished prior to the initiation of production. This increases technical risk and the likelihood that missile modifications would be required based upon flight test data received after production startup.



Unavoidable Adverse Effects

5

PROBABLE UNAVOIDABLE ADVERSE ENVIRONMENTAL EFFECTS

5.1 UNAVOIDABLE ADVERSE ENVIRONMENTAL EFFECTS

Topography (5.1.1)

Construction and operation of the test facility and missile flight tests would cause adverse impacts on the topography. The most immediate effect on the topography is aesthetic, resulting from visual exposure of bare cut slopes, alteration of the landscape, destruction of natural vegetation, fugitive dust generation, filling in stream channels and diversion of stream waters. Indirect impacts, caused by long-term responses to topographic alteration, include increased wind and water erosion, changes of the equilibrium of the streams, gullying, and stream siltation. Wind transport might modify the topography on a long-term basis by causing deflation of, and deposition downwind of, disturbed areas. Deposition of fine materials downwind may bury and eventually destroy vegetation, create new sand dunes and increase stream sediment loads. Modification of minor water drainages would create long-term impacts on the topography due to accelerated erosion and deposition.

Construction of the trench, shelter and appurtenant facilities would modify the topography with cuts and fills, and would damage surrounding soil and vegetation. This would lead to indirect topographic and geomorphic impacts, such as deflation and sand dune formation, that tend to develop slowly. Deflation and sand dune formation are most likely to occur at the San Antonio Terrace CSA. However, the potential for this adverse impact will be greatly reduced if all facilities are sited in the northeast portion of the siting area away from the rolling dune topography. Modification of minor drainages would alter the

natural pattern of water erosion and deposition which would be reflected in changes in the land surface. The Shuman Canyon CSA would be affected the most by surface water erosion and alteration of drainages.

Soil (5.1.2)

Soils would be disturbed, buried or lost along trench alignments in the areas of the shelters and at the appurtenant facilities. The soils at Vandenberg are subject to erosion if they are not protected and stabilized by vegetation or natural soil structure. Areas where the soil structure or vegetation are disturbed or removed by grading, earth moving equipment or vehicular traffic would be subjected to increased wind or water erosion. The stabilized sand dunes which are present in most of the coastal areas at Vandenberg are the most sensitive. Removal or disturbance of the root network on dune sands would expose all the underlying sand to wind erosion that could cause blow-outs and reactivation of the dunes.

Geology (5.1.3)

Seismic risks are the only geologic effects that cannot be avoided. Nevertheless, they can be mitigated by selective siting and by appropriate earthquake engineering.

Terrain modification in the course of construction would tend to alter the erosion cycle and, unless taken care of in the design, cause detrimental drainage changes and siltation. Increase of moisture content in affected, poorly consolidated materials because of heavy rains could produce liquefaction in the event of earth tremors.

Water Quality (5.1.4)

Most impacts of construction and missile test firing should exert only temporary impacts on the area's surface and groundwater quality, as most areas will eventually revegetate and contaminants will be washed away and diluted by seasonal rainfalls. Most of these temporary impacts will be unavoidable. The impacts from sediment runoff will be mitigated by natural attenuation due to terrain, by minimal removal of surface vegetation during construction, by placement of sedimentation weirs in ditches and valleys leading to tributaries and permanent ponds, and by adoption of measurements promoting natural revegetation of cleared areas once construction is completed. Recent upgrading of the Lompoc Regional Wastewater Reclamation Plant has effectively mitigated expected increased sewage loads due to influxes of construction and operation personnel, thus preventing the potential for further eutrophication of the

ecologically valuable lower Santa Ynez River and Lagoon. Increased load to the Santa Maria Wastewater Treatment Facility will not degrade ocean water quality because of quick dilution.

Air Quality (5.1.5)

In terms of the overall program at Vandenberg, unavoidable impacts on air quality occur due to dust and vehicle emissions during construction and rocket motor exhaust constituents during flight testing. In both cases the effects are transitory and the impacts small. The construction impacts are somewhat longer term and consist primarily of the effects of dust generation and construction vehicle emissions. Dust generation may attain a moderate level during the construction of the support facilities and the shelters. The trench mode, if built, will generate a larger dust load due to the larger area disturbed and the greater amount of soil material to be handled. Vehicle emissions are heaviest for the trench mode and less for the shelter, since fewer heavy equipment vehicle miles are required. In both cases workers' automobiles will contribute about the same amount of pollution each day as they travel to and from the job. This additional traffic will increase vehicle emissions over the present base levels. Subsequent to the active construction phase and following the cessation of dust generation, the vehicle traffic associated with MX testing will cause some vehicle emissions to continue throughout the program lifetime at Vandenberg.

The missile flight tests themselves will generate exhaust effluent clouds that require controlled safety zones out to distances of a few thousand feet from the launch points. The total amount of material released into the atmosphere as well as the portion near the ground is not accurately known at this time but the estimated impact for the missile which is larger than a Minuteman and smaller than a Titan III, would be bracketed by them. Although both missiles are launched routinely from Vandenberg, no residual impacts have been observed from either. Brief air quality effects from the MX launches may extend beyond the boundaries of the base, but pollutant amounts are estimated to be very low. Higher pollutant levels in the immediate vicinity of the launch point do occur, but monitoring on the Titan III program has not detected any air quality effects from the much larger missile.

The effects on air quality of dust, vehicle emissions and missile exhaust products are adverse in that they all degrade cleaner air by adding additional pollutants to it. The transient and limited nature of the missile exhaust reduces its impact as the dilution ratio is very high in terms of the amount of material put into the atmosphere compared to the volume of air involved as the exhaust cools. The dilution effect is found to a lesser extent for the dust and vehicle emissions. The impact on base-wide air quality is small for both, amounting to a few percent for the vehicle emissions and somewhat more for dust. Background

dust is not seen as an important pollutant at Vandenberg, as the air normally has a long over-water trajectory before passing over the base. The few months of additional dust generation due to construction of MX facilities would not be expected to have a measurable impact on the base air quality.

Noise (5.1.6)

Unavoidable noise effects of the MX program are largely from the increased traffic, the construction-related noise, and the missile launch-induced noise. None of this noise can be eliminated. Some of the noise may be reduced by revising the design of gasoline and diesel engines and installing noise elimination devices. However, due to the transient nature of these activities, it will not be cost-effective to install such sound reduction equipment. If community complaints are received as to the consequential noise, additional noise reduction measures will be considered. These measures may include rerouting the project-related traffic to a less populated route, reducing project-related traffic in the evenings, and avoiding conducting flight tests during sleep hours.

Terrestrial Biology (5.1.7)

Shuman Canyon Candidate Siting Area. Shelters and support facilities would be located in disturbed annual grassland habitat—minimum biological impact. The riparian scrub vegetation in the canyon and the sand dunes at its mouth are more sensitive; however, these areas seem to lack engineering suitability for facilities installation, thus are unlikely to be directly impacted by construction.

San Antonio Terrace Candidate Siting Area. Trenches, shelters, and support facilities would be located in a disturbed annual grassland habitat of low biological sensitivity. Low biological impact should result from construction of test facilities in this habitat.

Strong biological constraints are posed upon any alternative arrangements that affect the stabilized sand and dunes. This habitat type is designated as one of the "Areas of Prime Ecological Significance" on Vandenberg and reaches its best development in this candidate siting area. This habitat type is limited in areal extent, is relatively undisturbed, and is essential habitat for several endemic plant species including candidate endangered or threatened species.

Burton Mesa Candidate Siting Area. Shelters and support facilities would be located in disturbed annual grassland and their construction and operation should result in low biological impact. Trenches, however, would impact about 47.5 acres (19 ha) of the endemic chaparral Burton Mesa to which a

number of rare plant species are restricted. A large canyon supporting riparian vegetation important for wildlife could also be affected by MX construction and testing according to this layout. Substantial cumulative impact on vegetation (esp. chaparral) and wildlife would result from combined MX deployment in this candidate siting area and extension of the adjacent runway and facilities construction associated with the Space Shuttle Program. Impacts at this CSA would be substantially mitigated by using shorter (e.g., 1 mile [1.6 km]) trenches.

Lompoc Terrace Candidate Siting Area. Shelters would be located in annual grassland and would pose minimum biological impact; trenches would impact a substantial amount of a chaparral that is rich in plant species and supports relatively abundant wildlife. Construction of shorter (e.g., 1 mile [1.6 km]) trenches which would not impact the richest portion of this chaparral and their construction in an appropriate place in annual grassland would be a substantial mitigation measure.

Socioeconomic Effects (5.1.8)

An adverse socioeconomic impact in prospect is the development of increased demand for housing, with a consequent upward pressure on housing prices. While some observers believe that the great acceleration in housing price which has been characteristic of recent years has abated, this may be a temporary lull.

Future increases would not be attributed to the MX test program in a major way, since the local inflation has been stimulated by growth constraints in the major employment areas of the South Coast. The working population at Vandenberg has been virtually constant for several years. The future will be influenced by the area's basic industries — manufacturing and agriculture in the main — together with developments in education, tourism, and activities at Vandenberg.

The degree to which the MX testing may constitute an adverse impact on water supply depends upon the LNG, Shuttle, and MX programs as well as the local plans and decision processes underway concerning both water supply and economic/population growth management. Local governmental agencies are currently studying the prospect of importing water from Northern California, of instituting growth limitations in unincorporated portions of the county, and a proposal to a new county from that portion of Santa Barbara County known as North County. The outcomes of these decisions will affect the growth potential of the area. The effect of MX testing is necessarily obscure until the other program dimensions are known and the sociopolitical processes culminate in decisions and actions. With the major part of the impact period some years away, the influence of the MX flight tests and associated construction cannot be sharply delineated in a relative sense since the socioeconomic conditions at that time are still highly speculative.

Archaeology (5.1.9)

It is probable that even the areas of lowest archaeological sensitivity on Vandenberg (see Figure 1-35) will contain some archaeological sites. It is also probable that at least a few of these sites will not be avoidable through incorporation of modifications into the project plans. In such cases, the development of a data recovery program will serve to mitigate the adverse archaeological impacts. However, since archaeological resources are nonrenewable resources, their excavation or recovery in the present precludes their future utilization by archaeologists with improved archaeological method and theory. In order to minimize this unavoidable adverse effect, preservation of archaeological remains through avoidance will be followed as the most favored option, where feasible. When avoidance is not possible, data recovery will be carried out using the most appropriate current archaeological method and theory.

5.2 SUMMARY OF ADVERSE EFFECTS WHICH WOULD BE MITIGATED

Construction Phase (5.2.1)

Topography (5.2.1.1). Impacts on the topography will be mitigated by recontouring the land surface after construction to restore the natural appearance of the land surface, and revegetating to control wind and water erosion. Interim measures, such as fabric mesh covers may be implemented to prevent erosion prior to natural or artificial revegetation. Identified areas of high erosion potential, such as sand dunes or silty soils, will be avoided if possible.

The alteration of the natural contours of the land surface could be objectionable on an aesthetic basis, but could be mitigated by careful planning. This would include altering the layout of test facilities to be compatible with the existing land surface, using a balanced cut and fill plan, and recontouring after construction.

Shuman Canyon Candidate Siting Area. Aesthetic impacts will be lessened by careful planning, by designing facilities within constraints imposed by the natural topography, and by balancing cut and fill requirements.

San Antonio Terrace Candidate Siting Area. Wind erosion during construction could be minimized by applying enough moisture to spoil dirt piles to prevent eolian transport. Little could be done to mitigate changes to the original land forms. However, it is expected that recontouring and revegetating cut and fill slopes could reduce the visual impact of the scars significantly. The same mitigative measure could reduce impacts caused by wind.

Lompoc Terrace Candidate Siting Area. Wind erosion during construction may be mitigated by the application of water to areas of exposed sand or spoils. Impacts on topography after construction would be minimized by recontouring and replanting the area so as to restore it, as closely as possible, to its natural condition. Revegetation would also prevent further erosion during operation of the facility. Re-

Recontouring the berm areas and revegetating the exposed soils would mitigate future erosion impacts, as well.

Soils (5.2.1.2). The prime mitigative action is avoidance; that is locating the test facilities away from stabilized dunes. Revegetation or other erosion control mechanisms would reduce long-term effects of soil disturbance.

Impacts due to adverse engineering properties of the soils cannot be assessed without data on the specific soils. There is a potential for expansive soils at the Shuman Canyon CSA, while the San Antonio Terrace, Burton Mesa and Lompoc Terrace CSAs may have areas of compressible soils. Compressibility can be induced by increasing the amount of water in the spoils. The impact of adverse engineering properties can be mitigated by design in suitable foundations to accommodate the expected soil conditions.

Shuman Canyon Candidate Siting Area. The clay content of the soils helps prevent wind erosion; however, disturbed soil areas might experience accelerated water erosion if restoration of vegetation were not instituted.

San Antonio Terrace Candidate Siting Area. All of the areas where the vegetation is removed or where fill is placed, including the buried trench and shelter berms, would be revegetated to prevent erosion and restore the site as nearly as possible to its original conditions. This procedure is in accord with good grading practice and Vandenberg AFB directives.

Before significant erosion of exposed sand can occur, the slopes and exposed sand areas would be revegetated and would require a fabric-mesh cover or other erosion control method, while the planted vegetation takes hold. Generally, mitigative measures applied at Vandenberg for the disturbances of soils on San Antonio Terrace would produce impacts of low to moderate sensitivity and magnitude.

Burton Mesa Candidate Siting Area. Much of the natural vegetation and protective cover of the sands of the Orcutt Formation would be removed during construction. The disturbed areas would be revegetated according to Vandenberg directives to restore them to their natural condition.

Lompoc Terrace Candidate Siting Area. Because much of the existing soil would be disturbed and subject to erosion, the bare soils, cut slopes along the roads, and trench or shelters would be reseeded to restore, as nearly as possible, the natural conditions of the area.

Geology (5.2.1.3). Earthquake and landslide impacts will be avoided to large degree by advanced planning and safety precautions. Earthquake effects such as surface faulting and soil liquefaction will be mitigated by adjusting the facilities to avoid hazardous areas. Liquefaction also will be mitigated by draining the areas with liquefaction potential.

Cut slope failures will be prevented by designing slopes based on the engineering properties of the materials forming the slope or where dip planes are not adverse, by cutting the slopes to inclinations of less than 30 degrees. Temporary vertical or near vertical slopes such as in trenches can be stabilized by shoring in the excavations.

Most hazards due to seismic activity along the Lions Head fault could be mitigated during design and construction phases, by good engineering practice. Areas where the fault trace has been mapped will be avoided to mitigate surface faulting at the facility. Earthquake engineering will be taken into account during the design of the facilities.

Soil failures of low volume could be expected during excavation for the proposed facilities. These failures would have little effect on the proposed test facility but could be a nuisance, and even dangerous, to construction crews. The effects would be very short-term, occurring during excavation only. They could be mitigated: by specifying safe angles for cut and fill slopes after the soil properties at specific locations are ascertained; and proper shoring and retention of weakened ground.

San Antonio Terrace Candidate Siting Area. Areas identified as having soils subject to liquefaction could be drained. Hazards related to slope failures could be mitigated by cutting slopes at stable angles based on the engineering properties of the soils. The worst potential for slope instability would be in loose, unconsolidated sands where maximum slopes would adjust to the natural angle of repose (30 degrees).

Burton Mesa Candidate Siting Areas. Mitigation of seismic impacts could be accomplished by designing the test facility to withstand the maximum potential ground acceleration value determined for the project. Landslide and slope stability hazards could be lessened by proper design based on soil properties determined by field and laboratory testing. Loose, unconsolidated sand would form the least stable slopes; these would adjust to the natural dry angle of repose of about 30 degrees. Shoring of vertical-sided excavations would be required for safety below depths of 5 ft. (1.5 m).

Lompoc Terrace Candidate Siting Area. Seismic shaking can occur at the Lompoc Terrace CSA during an earthquake on the Lions Head or Hosgri faults. The effect of this shaking could be mitigated by designing test facilities to withstand the maximum expected ground motions.

Soil and slope failures might occur in front or side cuts in areas of excavations. This could be mitigated by appropriate design of the cut slopes with flatter angles, or by shoring unstable slopes during construction.

Hydrology (5.2.1.4). To minimize the impact of erosion all landfill material will be suitably compacted to reduce the potential for erosion and infiltration.

In the post-construction period a program of revegetation of the site will aid in reducing potential soil erosion.

To minimize the potential of liquid wastes contaminating either surface water or groundwater supplies during construction or operation of the test facilities, applicable regulations governing the handling, shipment and storage of these materials will be enforced.

Shuman Canyon Candidate Siting Area. Long-term effects will be avoided by post-construction revegetation of the site to near its natural condition.

San Antonio Terrace Candidate Siting Area. Spoils berms about the trench could result in changes to existing drainage patterns, therefore, drainage ditches will be required for the purpose of carrying storm runoff and preventing erosion of the berms.

Burton Mesa Candidate Siting Area. Construction of facilities and associated roadside drainage ditches could cause minor changes in the drainage patterns of the site, such as modifying existing overland flow patterns. Orienting the roads parallel to existing overland flow paths would minimize the impacts.

Lompoc Terrace Candidate Siting Area. Spoils berms about the trench would result in changes to existing drainage patterns, therefore, drainage ditches will be required for the purpose of carrying storm runoff and preventing erosion of spoils berms.

Water Quality (5.2.1.5). Mitigation of any potential erosion to prevent increased sediment runoff will involve temporary ground covering with erosion netting or burlap cloth and berm and weir construction. Permanent revegetation will replace temporary ground covering for long-term mitigation.

Air Quality (5.2.1.6). Mitigation measures such as dust suppression and vehicle emissions control are assumed to be an integral part of the programmed activity. Additional scheduling considerations to accomplish major trenching or earthmoving in the winter season would take advantage of higher soil moisture levels to further reduce dust potentials, if necessary. An additional or alternative approach would be to accomplish major earthmoving requirements during periods with offshore wind or winds not directed toward populated areas.

Terrestrial Biology (5.2.1.7). Important mitigation measures to reduce or avoid impacts to the terrestrial biota include:

- Avoidance of sensitive vegetation/habitat types (coastal sage scrub - stabilized dune phase and chaparral) by choice of site or location of facilities on the site.
- Conservation and replacement of at least the uppermost few inches of soil over trench fill. This provides not only a medium for plant growth - but also an inoculum of native seeds and soil organisms.
- Stabilization of slopes with burlap where necessary.
- Avoidance of planting introduced species for purposes of soil stabilization.
- Construction of the minimum amount of access roads and strict confinement of equipment activity to designed corridors.
- Stockpiling and replacement of the soil or the upper substratum layers (where true soil is lacking) after construction to enhance rates of natural revegetation by providing a favorable substratum and a natural, in situ, seed reservoir.

Aquatic Biology (5.2.1.8). Several mitigation measures will be implemented during the construction and testing phases of this project in order to minimize potentially adverse impacts to both freshwater and marine biota. These measures are:

- Berms, weirs, terraces, etc. will be utilized as necessary during construction to prevent excessive runoff to water bodies.

- Disturbed areas of spoils may require stabilization before the rainy season.
- Runoff from large impervious areas will be controlled by appropriate techniques such as collection and diversion to settling basins or percolation areas.
- No water will be withdrawn from San Antonio Creek for construction uses.
- No missiles will be landed in San Antonio Creek during the ejection tests.

Socioeconomic Impacts (5.2.1.9). Mitigation for the cumulative construction worker housing impact of Shuttle and MX, and possibly for the separate effect of MX, will be provided by the Air Force. On- or off-base parking areas for 75 to 100 recreational vehicles will be sufficient to offset the increase in demand for housing of this type.

In order to mitigate reduction of the existing landfill's lifespan, inert solid waste from MX construction is expected to be collected in one of the topographical areas similar to the existing solid waste disposal on-base facility.

Archaeology (5.2.1.10). The following mitigation measures, when instituted, will serve to minimize the adverse impacts of project implementation on archaeological resources.

- Limited archaeological survey will be carried out in each candidate siting area in order to obtain the data necessary for making an informed choice between the siting alternatives.
- The project will be sited in the area of lowest archaeological sensitivity that is compatible with general project needs and other environmental considerations.

Additional archaeological survey of the area selected for project siting will be prepared.

- An archaeological management plan that will result in the long-term preservation of as many archaeological resources as possible will be developed.
- In those cases where preservation of archaeological resources is not possible, a data recovery program will be developed and instituted.

Specific measures to reduce or eliminate any potential indirect impacts can be developed once a siting area has been selected and a facilities layout plan has been designed.

Operational Phase (5.2.2)

Topography (5.2.2.1). Breakout testing from buried trenches would cause minor local disturbances of recontoured ground at the breakout point. Those disturbed sites would be restored and replanted according to the same procedures for restoration after construction of the trench.

Shuman Canyon Candidate Siting Area. Inspection and evaluation recovery areas and vehicle traffic lanes would govern whether the areas need to be replanted. Most of the effects from missile impact and recovery should recover by natural processes and need not be mitigated.

San Antonio Terrace Candidate Siting Area. To mitigate the potential effects of wind or water erosion after missile impact and retrieval, revegetation should be implemented in areas of exposed erodible soils. Areas of breakout tests for the trench mode would cause similar short-term topographic and geomorphic impacts that could easily be mitigated by recontouring and revegetation of the affected areas.

Burton Mesa Candidate Siting Area. All operations impacts would be minor and can be mitigated by recontouring and revegetating affected areas.

Lompoc Terrace Candidate Siting Area. Recontouring and revegetation will be implemented in areas where modified topography results in exposing erodible materials.

Soils (5.2.2.2). Efforts to remove spilled materials would involve removal of the upper few inches of soil (± 10 cm); thus, the underlying unstabilized sand would be exposed to erosion agents. These areas will be restored by planting vegetation to prevent erosion and scars on the landscape.

Shuman Canyon Candidate Siting Area. Impacts related to soils during missile testing would be minimal at the Shuman Canyon CSA as the trench mode would not be tested here. Activities that might disturb the natural soil cover and thus accelerate erosion will be mitigated by restoring vegetation or providing ground cover to stabilize the surface.

San Antonio Terrace Candidate Siting Area. Mitigative measures would be the same as those for construction impacts including a fabric mesh cover or other erosion control methods while vegetation is re-established.

Burton Mesa Candidate Siting Area. The effects of those soil disturbances could be minimized by re-establishing vegetation over areas of exposed soil.

Lompoc Terrace Candidate Siting Area. Soil will be disturbed during some of the launch activities that would include off-road traffic and breakout of missiles from buried trenches. Those areas would be subject to local wind and water erosion effects but are expected to be very minor at Lompoc Terrace. Mitigation of those effects will include revegetation of areas of soil exposed to erosional agents.

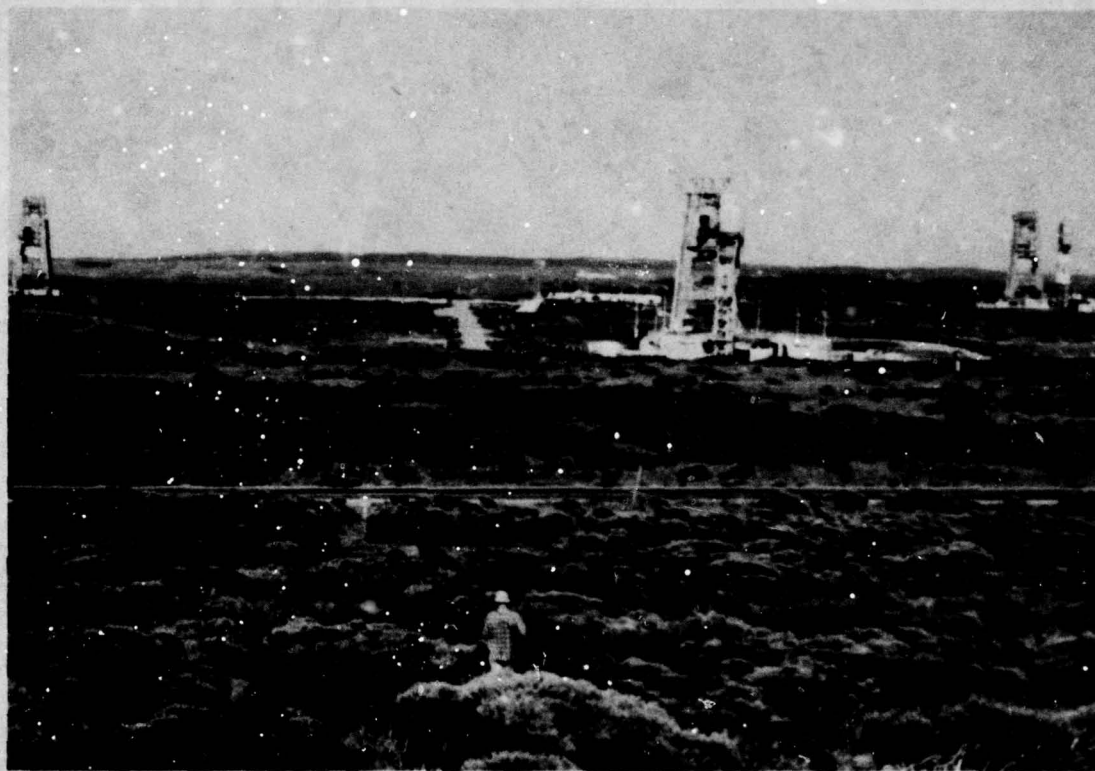
Geology (5.2.2.3)

Shuman Canyon Candidate Siting Area. Preventative measures will be taken to locate facilities away from mapped segments of the fault. Design consideration for structures could accommodate the potential seismic shaking at the site but some short-term disruptions of facility operations might be unavoidable during strong earthquakes.

San Antonio Terrace Candidate Siting Area. The short-term impacts due to ground shaking cannot be mitigated, but severe damage to facilities could be avoided by advanced design planning.

Burton Mesa Candidate Siting Area. Ground shaking due to an earthquake along the offshore Hosgri fault or distant faults might affect the Burton Mesa CSA. This impact might be mitigated by preventative design and construction methods. Some minor disruptions of facility activities would be unavoidable in the event of a strong earthquake.

Lompoc Terrace Candidate Siting Area. The Lompoc Terrace CSA may experience ground shaking due to activity along the Lompoc, Hosgri or distant faults. Surface rupture may occur on the Lompoc fault or the unnamed fault to the north. The effect of this ground failure on MX testing could be mitigated by proper design and by locating structures off the mapped fault traces.

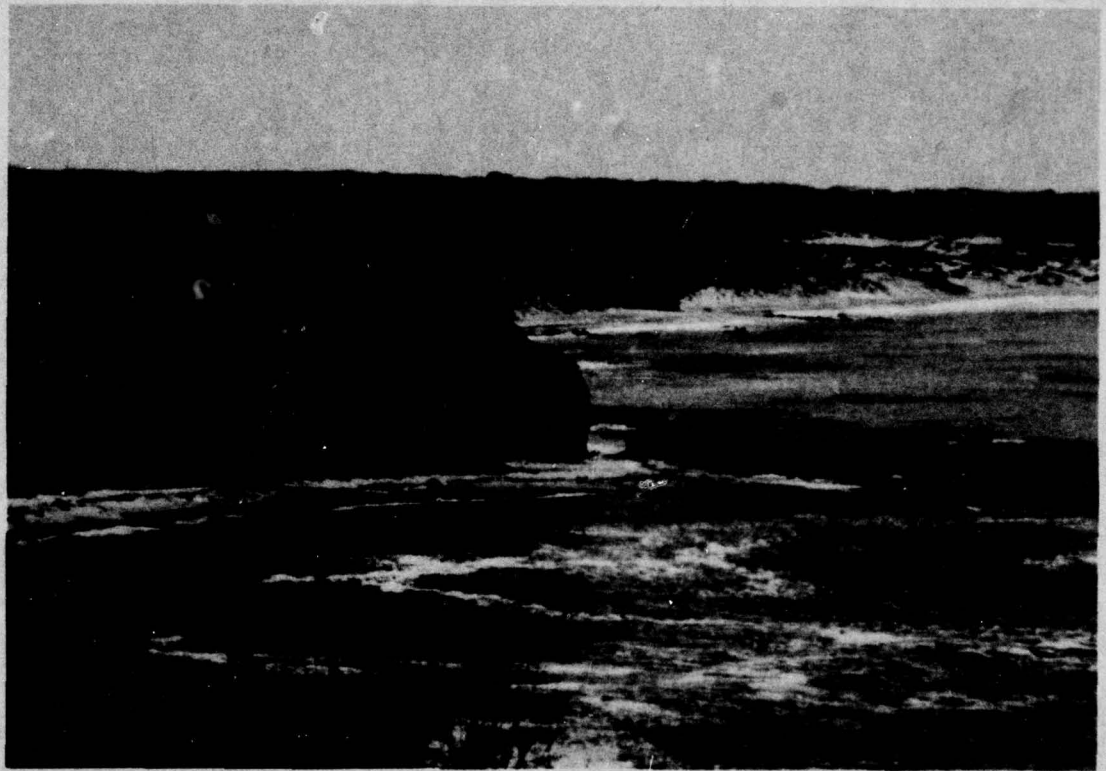


Short-/Long-Term Productivity

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RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND LONG-TERM PRODUCTIVITY

- The MX flight test program at Vandenberg will generate additional income and employment in the local and regional areas. This will be generally consistent with local goals concerning growth, and it will maintain Vandenberg as a significant part of the local area's economic base.
- In the 1980 to 1981 period in particular, MX construction effects will add to the effects of the Shuttle and LNG activities, should their proposed schedules occur, and create a severe strain on construction worker availability, housing supply, and infrastructure capacities. If the three programs do not peak at the same time, the housing problems will be altered from a requirement for temporary residences to a requirement for permanent ones.
- In the long term, the MX project will add to the local export industry (or economic base) and accelerate overall development. Continued SAC training programs should serve to stabilize regional employment, especially within the Lompoc Valley.
- The long-term consequences include helping to validate the MX system's capability to maintain the nation's deterrent posture through maintenance of strategic forces which can survive attack in sufficient numbers to ensure significant damage to an enemy power.
- On-base lands will be dedicated to the MX project. While these lands could be rededicated to alternative future uses following their useful life for MX, this probably represents a long-term impact but will have a minor impact on long-term productivity.
- Off-base lands will be dedicated to commercial and residential development in support of new economic and population growth induced by the project. The impact depends on the specific lands developed and this cannot accurately be assessed at present. So long as this growth is consistent with local plans, no significant impacts on long-term productivity are anticipated.



Resource Commitments

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Construction Phase

- During the construction period, the major commitments of resources include the use of material such as cement, aggregate, plastics, steel, aluminum, other metals, petroleum products, wood, electric energy, and human resources. The resources, except for recyclable items, will be irretrievably lost.
- The land that will be occupied by the MX facilities will likely not be employed in other uses or be removed unless there is a significant mission realignment at Vandenberg. The facilities could be modified for use in other programs subsequent to completion of MX program requirements. Hence, it cannot be said that the commitment of land to the project is absolutely irreversible.
- Some irretrievable loss of archaeological sites may occur during construction. However, archaeological losses can be partially offset by the development and implementation of a data recovery program.
- Most of the materials and resources that would be committed for the flight test program are not in short supply. Construction materials such as wood, asphalt, aggregate, paint, fuel, and structural steel are readily available from suppliers in the region. Cement is not readily available at this time, but long-term market conditions may alleviate the situation prior to actual construction.
- Construction of the facilities will displace fauna by removing habitat in the construction zones. Portions of the area could be restored to its native condition following the useful life of the project.

Operation Phase

- The major commitments of resources include nonrecyclable materials in components, petroleum based fuels and paints, solid liquid rocket propellant, and human resources.
- Certain exotic, unique, or particularly valuable materials or other resources (such as precious metals and special ceramics and cements) may be expended and irretrievably lost during the fabrication of components of the missile or expended during launch operations.
- Some growth of local communities with related conversion of open space or undeveloped land to urban uses will result from the project, although the extent of change cannot be accurately determined from planning efforts to date. Even under the greatest growth analysis presented in this report, the expected growth attributable to the proposed action is a small fraction of the growth expected without the project.

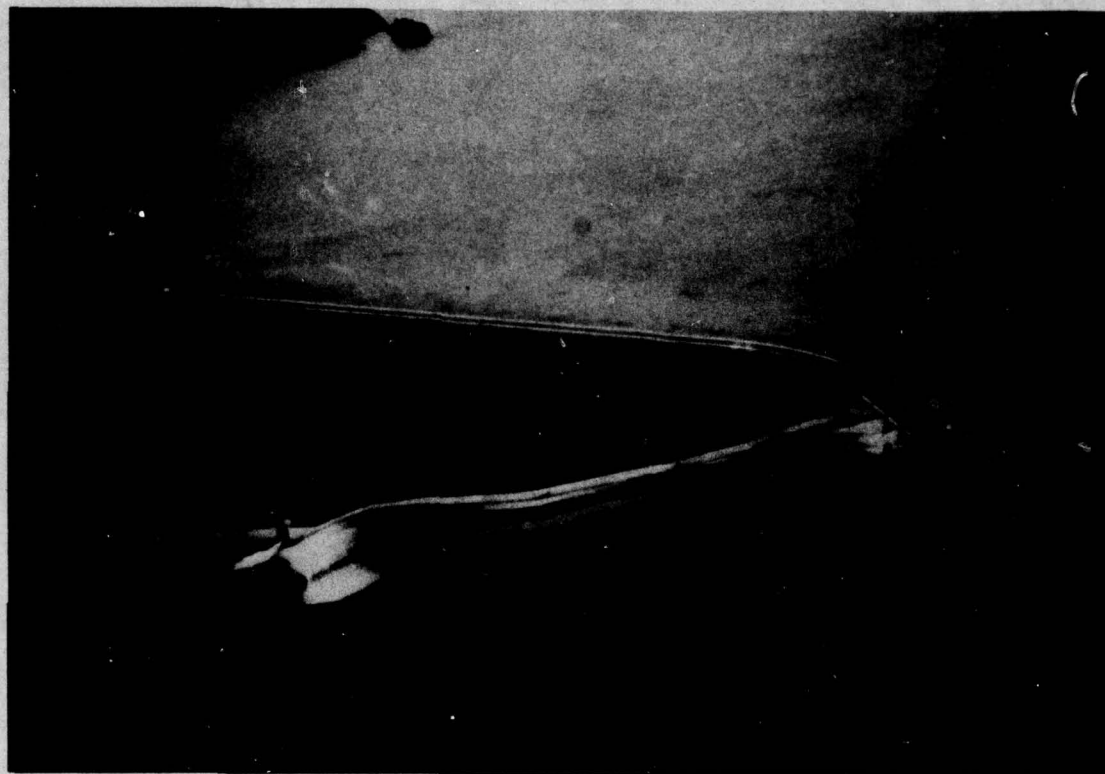


Offsetting Considerations

CONSIDERATIONS THAT OFFSET THE ADVERSE IMPACTS

Decisionmakers have several major considerations which must be included as part of the evaluation of the MX weapon system testing at Vandenberg. These considerations must be carefully weighed to determine the extent to which they offset adverse environmental effects. Some of these considerations are as follows:

- The successful development of the MX weapon system and validation by the flight test program will provide deterrence to the growing USSR threat. Security is a major national priority. Within this framework, all other impacts and considerations must be evaluated.
- The state-of-the-art in numerous fields will be enhanced and advanced through the MX weapon system test program including large construction equipment, machinery, materials and construction techniques (subways and pipelines); large ground vehicles; command, communication, command equipment and methods, and military operations. Spinoffs from a program of this magnitude and variety of development areas will be great.
- Advancements will occur in environmental analysis, reporting, procedures, and methods. This improvement in the state-of-the-art will benefit both private and public protective and enhancement actions in a wide range of future projects. This offsetting consideration also includes the generation of great quantities of baseline and specific data and the development of advanced analysis techniques, methods, and procedures, as well as a highly trained personnel base to implement, evaluate, and operate environmental programs in the physical sciences, biological sciences, and socioeconomic disciplines.



Unresolved Issues

- Test facilities are planned for conversion to training facilities for Strategic Air Command and support command personnel for use during the life cycle of the MX program.
- Trenches or shelters, support facilities, and road systems could have test mission application in support of other programs. Because of the unique character of the items, alternate nonoperational air base use could develop.
- To the extent that MX ultimately replaces the Minuteman or other test requirements at Vandenberg, these areas and facilities may be released for other uses.

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DETAILS OF UNRESOLVED ISSUES

The following issues are currently unresolved and have not been addressed in detail in this environmental impact statement. These issues could have adverse effects and/or could be mitigated effectively with regard to potential environmental impacts. Additional program details and ongoing review are expected to resolve many of the issues presented in this section.

- Firm configuration of the specific missile to be tested, the basing mode (trench or shelter), ground vehicles, support building and associated items, construction methods, locations, and materials will require additional design detailing not available at the time of report production. Variances of impacts by location and degree from socioeconomic, biological, and physical perspectives can be extensive.
- Mission realignment may result in different uses of the test site location after the completion of the test program. These alternative uses cannot be anticipated at this time.
- Environmental impacts to the base and community in the event the test program is cancelled have not been addressed.
- Shortages or stoppages could occur as a result of resource availability such as concrete. The impacts of such events on the project schedule and costs are uncertain.
- Recent water resources issues in Lompoc Valley could affect the future supply of single and multiple family dwellings and export the growth associated with MX operations to other areas of the North County.

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